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AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Keeping Faith With Those Who Died

THERE is a far-reaching appeal in the attractive poster which is a supplement to this issue of *Engineering News-Record*. Primarily, of course, its object is to preach the need for a full subscription to the Victory Liberty Loan, but the reader who draws only this inference gets only part of the message. Liberty is appealing to everyone, employer and employed, to keep the faith—and that appeal extends to every feature connected with or flowing out of the war. We must keep faith

By oversubscribing the Victory Loan;

By doing justice to every worker and by meeting with patience and in a spirit of compromise the troublesome industrial problems ahead;

By rendering a fair day's work for a fair day's pay;

By insisting that the way of sound progress is by evolution, not revolution;

By making, each in his particular job, whatever sacrifices are necessary to bring about that reign of justice for the attainment of which our sons and brothers suffered and laid down their lives.

Light Aggregate Promises To Compete With Stone

WHAT is virtually a new structural material is made possible by the light-weight concrete aggregate whose properties and methods of manufacture are outlined on another page. Structural concrete rarely requires the weight that generally is necessary or at least useful in mass concrete or masonry. Every pound that is gained without loss of strength is a saving multiplied many times in the reduction of other members proportioned to carry dead as well as live load. Ten months of experimenting have demonstrated that a satisfactory artificial aggregate can be made almost anywhere in this country, and that the technique of its manufacture, while not easy to be learned, can be developed in many types of kiln. The crucial element yet to be determined is its price, and a favorable reply to this question will be eagerly awaited by structural engineers. If such a material can be put down on the job at competitive figures, the stone and gravel men will soon find that their selling problem has taken on new difficulties.

Typhoid Honor Roll Continues To Lengthen

NOTHING can be more gratifying to the sanitary engineer and few things more satisfactory to public-health men generally than the continued decline of typhoid fever. No fewer than 22 cities in 1918 won a place on the provisional typhoid fever honor roll suggested for cities by *Engineering News-Record*, in the issue of Oct. 18, 1917, p. 723. The standard then set tentatively was a rate of 5 per 100,000 or less. Six more cities gained places on this roll in 1918 than in 1916. Some years ago a typhoid rate of 20 or under per 100,000 was considered creditable, and anything over that as indicating, though not proving, a polluted water-supply. In 1918 there were only five cities in the above-20 class, compared with eight in 1916. The detailed figures on pp. 812-813 deserve study, especially by engineers and health officials in cities whose rates are still high. The need for most watchful attention in 1919 will be great, in view of the possible spread of typhoid by demobilization. During the latter part of 1918 and early in 1919 typhoid in our Expeditionary Forces, although still low, increased considerably, as noted in *Engineering News-Record* of Apr. 3, 1919, p. 677. As the forces return there may be among them a sufficient number of carriers, even if not of sick or to-be-sick cases, to spread innumerable typhoid germs in this country. The wise health officer will be on the lookout, ready to act the moment there is the slightest evidence of an increase in typhoid.

The Electric Railway Versus the Motor Truck

RECENTLY the executive secretary of the Highways Transport committee, in addressing a meeting of motor-truck salesmen, pleaded earnestly for coöperation between motor-truck interests and the electric railways, pointing out that the latter were in a bad way financially and needed help in order that the investment represented might be conserved. All will agree with him that it will be a national loss if widespread financial disaster overtakes the electric railways, urban and interurban. Also, when coöperation can produce economies there should be coöperation. The burden, however, is not so much on the motor-trucking interests as on the electric railways. The latter were first in the field. They had a great opportunity to develop intercity express service, and, by and large, had not the business acumen to grasp it. Now they must not whine when a new type of carrier, with great intrinsic merits and under skillful promotion, comes in to preëmpt the field which in great part might have been theirs. Their efforts must be directed not to recommendations of cooperative discussion but to actual demonstrations of economy in freight carriage. The burden is clearly upon the electric railways, not on the operators and advocates of motor trucks. Theoretical discussions have some value as contributions to engineering knowledge, but they do not take the place of demonstrations and records of fact in the application of new methods in this workaday world.

An Influential but Unobtrusive Organization

THE publication elsewhere in this issue of the remarkable address on prices by O. P. Austin, chief statistician of the National City Bank, New York, makes opportune the mention of an organization which in an unobtrusive way is having a very definite influence on the industrial life of the nation. The organization in question is the Editorial Conference of the New York Business Publishers' Association, composed of the editors of the leading technical and trade papers published in New York City. The purpose of the conference is to consider problems that affect industry and business generally, to the end that the editors may have available the best information obtainable in formulating their policies. During the war, for example, there were two conferences at Washington, at which members of the cabinet and heads of important bureaus laid before the editors the main features of important war activities, while at the New York conference at which Mr. Austin's paper was read three big topics were set for discussion —post-war finance, industrial coöperation and foreign trade. These were discussed by the most eminent men obtainable. Besides Mr. Austin, the financial problems were covered by Francis H. Sisson, vice-president of the Guaranty Trust Co. and Prof. Irving Fisher. Dr. Charles P. Steinmetz, V. Everit Macy and Dr. Charles A. Eaton discussed industrial coöperation, while G. A. O'Reilly presented the problems of our foreign trade. While there is no thought of imposing opinions and policies on the editors, the influence of the organization is nevertheless potent, for it is an instrument by which there is constantly made available to the editors the very best thought on urgent general problems.

Cost-Plus Contracts Do Not Encourage Low Labor Output

STUDENTS of cost-plus contracting—and that means almost every engineer and contractor—will be interested in the evidence of its cost efficiency which is presented by Henry C. Turner of the Turner Construction Co., on page 815 of this issue. It is good management and not the form of contract which determines the efficiency of labor in construction; it was floating labor and shortage of trained workmen which caused the low records of labor output in war construction. Seldom has any fact in construction practice been demonstrated more convincingly than these are shown by Mr. Turner's article. For the first time cost comparison of percentage and lump-sum contract work is made.

War construction accomplished much in educating the construction industry to the possibilities of cost-plus contracting. Unfortunately, it also did much to cast suspicion on this form of contract. War construction was wastefully extravagant in the expenditure of labor. Workmen of all classes were most inefficient. Unit costs of construction ran high. These facts may not be denied. They are being charged to the cost-plus contract. If this charge is not to hold good in the opinion of the building public, the true reasons for inefficiency of labor in war construction must be demonstrated. The article here considered comes closer to furnishing the unimpeachable evidence required for complete demonstration than any utterance heretofore made.

Presentation of the precise figures of comparison is left to the article itself. Two broad conclusions stand out from the detail. One is that in a properly organized construction company there is no difference in efficiency in labor engaged in percentage work and that engaged in lump-sum work. The second and equally important conclusion is that there is no reason or justice in forming an opinion as to the advantages of percentage or lump-sum work based on war construction experience.

Wider Use of Standards Should Be Promoted

WHY is it that in some cases important standards of engineering design and practice fail to be used generally even by members of the technical associations that formulated and adopted them? We speak of those standards, such as rail sections, which acquire their greatest value only through practically universal use.

Doubtless inertia is one large factor in the case. Pride in personal designs and prejudice against the standards are others. Positive or well defined objections also play a part, of varying magnitude.

If these are the principal causes operating against the standards, certain obvious remedies are available. For inertia and prejudice the remedy lies in insistent promotion or education, not only as to individual standards, but especially as to the broad advantages of uniformity and the necessity of some amount of compromise or even sacrifice to produce these advantages. Where specific objections are urged against the standards these objections must be analyzed and the reasons for allowing them to outweigh the advantages of uniformity must be brought into the light of day. By means of such methods it is possible to make headway in extending the use of the standard, and thereby transform a potentially valuable document into a productive asset.

A moment's consideration of the special case of rail sections may be illuminating. In touching upon the subject of standardization in his presidential address to the American Railway Engineering Association, C. A. Morse referred to the unnecessary number and variety of rail sections and stated that at the present time 12 sections of 100-lb. rail are being rolled. It is beyond all probability that each one of these is superior to all the others under the conditions of the road or roads using it. On the contrary, it is safe to say that the difference between some of the sections is comparatively or absolutely insignificant, so that other sections would give equally good service. In regard to such cases, it would be pertinent to ascertain the extent to which these special sections are used, and the reasons for not substituting standard sections. Some of the reasons would doubtless appear weak in the light of expert analysis.

Special sections mean extra expense and trouble at the mills. Orders for them cannot be filled from stock, as can those for standard rails, but must wait until the mill has time to change the rolls. Such changes also involve time and money, spent to no useful purpose. In fact, if large amounts of several special sections should be ordered at the same time during a busy period they would constitute a distinct bar to rapid and economical production or output. The same remarks apply to railway splice bars and to many other manufactured parts.

Technical associations having standards should promote their use by informing consumers of their advantages and by finding and combating the objections urged against them.

Expiration of the Norcross Flat-Slab Patent

ON APRIL 29, 1919, the famous Norcross patent, U. S. No. 698,542, on reinforced-concrete flat-slab floors expires, and with it, according to the present legal status of the case, goes the right of the Flat Slab Patents Co., the present owner of the patent, to charge a royalty or to issue a license for the construction and use of a flat-slab floor. This right has been generally recognized since the 1918 decision in the Lauter Piano case, and by many admitted since the 1914 Drum vs. Turner decision. It has been so recognized, however, not because engineers believe those decisions to be just or reasonable, but because it became evident that the complicated legal patent procedure had firmly established the Norcross patent as the basic patent on flat slabs and that it would be futile to try to override the precedent of two original Circuit Court decisions, with several confirmatory later decisions.

It is not the intention of this journal now to enter into a discussion of the evidence and procedure which marked the various Turner-Norcross patent cases. The printed record of those cases occupies many volumes, and only one who was forced to do so would attempt to wade through it. Certainly, the various engineering experts on both sides, whether intentionally or not, succeeded in obscuring the real issue and in confusing the judges as to the technical questions involved. It is of interest, though, to note that the two cases are founded on diametrically opposite principles. According to the Drum-Turner decision, Norcross showed invention in his novel arrangement of steel in a flat-slab floor, although obviously flat-slab floors had been previously patented and built. The later Lauter decision held that Turner's patent infringes Norcross' because its difference in placing reinforcement does not constitute invention. In other words, the first case sets up Norcross as a basic patentee on analogous grounds to which the second case denies invention to Turner. To confuse matters, in a later decision the Drum-Turner court specifically stated that it considered the Norcross invention to lie in a floor without supporting beams, not merely in the location of the reinforcing rods.

In practically all of the other reinforced concrete patent cases there has been a growing movement toward consistent thought. Arrangement of reinforcement to meet stresses is now fairly definitely established as mere engineering design and not invention. On such a basis neither Turner nor Norcross was entitled to a patent, because both developed through ready processes of engineering thought a type of structure established by record if not by extensive practice. A flat reinforced-concrete slab, supported on four columns, antedated both patents. Whether the designers and builders of these earlier slabs understood the actions that took place in the structure or designed correctly to meet those actions, is not pertinent if there was sufficient suggestion in them to permit an engineer skilled in structural design to adapt the principle to meet acceptable theory.

The progress of the litigation and the subsequent success of the Norcross patent, with its levying a tax on hundreds of structures, was a legal victory entirely and not an engineering one. No one doubts that Turner developed a commercial flat-slab floor, though few agree with his highly optimistic views on the strength of his floors. On the other hand, the Norcross case bore every evidence of lying only in a paper patent put forward to fight Turner's claims for invention and his prospective, if not actual, demands for royalty. Neither patent, in the views of most engineers today, was anything but a step forward in design, and the enforcement of a tax to be paid to either one of the patentees on the ground that his was a broad basic patent was bound to be resented as a legal imposition, although unfortunately there was no redress when once the courts had made their decision.

The Concrete in the Teaching of Engineering

DISCUSSIONS of engineering education have been so frequent recently that one is inclined to pass them by and to await the action of the colleges before indulging in more theory. However, we believe that engineers will read with more than ordinary interest the clear, forceful presentation of the plea for the concrete teaching of engineering made by Professor Morrow on page 827 of this issue. His views on his major topic are not altogether novel, but he repeats them with a strength and conviction that throw them into higher relief than in any presentation that has come to our attention.

Briefly, he pleads that the fundamentals of engineering—physics, chemistry, mathematics, etc.—should be taught in the applied manner. He would show through the concrete how things are done, and then seek the causes. Obviously, the teaching of the fundamentals would not follow after the engineering experiments themselves, but would go hand in hand with them. The same thought dominates the coöperative system of education as developed at Cincinnati, but it is clearly apparent that the method proposed by Professor Morrow can be applied at institutions far removed from industrial centers. It is a difference in spirit rather than equipment that is determinative in his scheme.

The danger, as we see it, in the plan he proposes is that which inheres in any scheme of education which stresses practice rather than theory; namely, that the student may be inclined to apply the quantitative standard not merely to the engineering works with which he deals, but to all other factors in life. It may be answered that even the abstract teaching of science has the same tendency, but we are inclined to believe that the stressing of principles which comes in the older method of teaching has somewhat the advantage as to this feature over Professor Morrow's scheme.

In criticising Professor Morrow's proposals we are not to take his attitude on the teaching of the engineering fundamentals as the whole of his plan, for when the latter part of his paper—that referring to the humanities—is taken into consideration, the first objection to the materialistic tendency of his proposed method of teaching engineering is largely removed. The problem is one of spirit just as much as method. An engineering faculty with little sympathy with the humanities could work much mischief, in the way of turning out one-sided men, with a plan such as Professor Morrow's. On the other hand, if the leaders are cultured men with a clear vision of the type of student they wish to turn out—young men prepared to take their places not merely as engineers but as citizens—the concrete teaching of the engineering subjects would be mellowed by the correct emphasis upon ideals.

History and Properties of Light-Weight Aggregates

Burnt Clay or Shale, Producing Material Full of Nonconnecting Cells and Making Concrete of High Strength and Light Weight, Developed by Government's Concrete-Ship Engineers

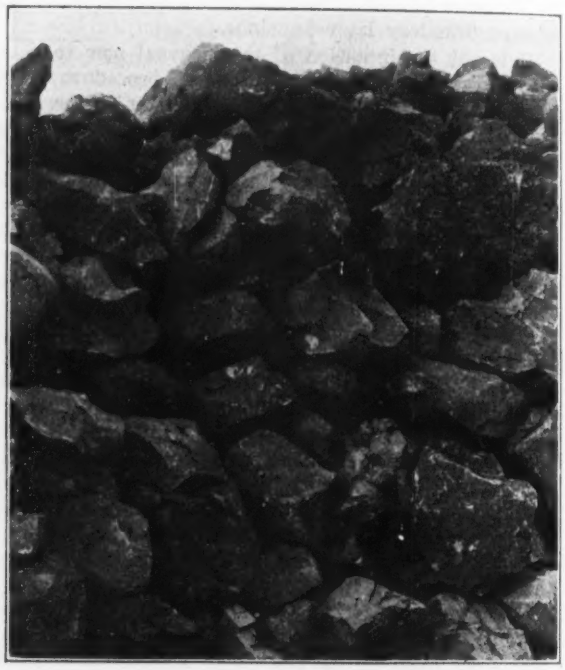
LIGHT-WEIGHT aggregate made from an artificially burnt shale or clay is now being used for the concrete on all of the Government concrete ships. The concrete so made, in rich mixtures and with a fine-ground cement, weighs from 100 to 118 lb. per cubic foot, and tests in compression from 3500 to 5500 lb. per square inch at the end of 28 days. Furthermore, it is impermeable, readily workable, and, so far as has been ascertained, has no defects not common to concrete with any of the more generally used aggregates. This artificial aggregate has been developed by the concrete ship section of the United States Emergency Fleet Corporation, but until now no definite statement of its method of manufacture or of its properties has been given out. *Engineering News-Record* is permitted here to make public the present knowledge of the material.

Early in the study of the concrete ship it became evident that to compete commercially with wood and steel the concrete must be lighter than the 150 lb. per cubic foot of the structural mixture commonly used. Naturally, low-weight concrete meant a low-weight aggregate. Many investigations were made into the possibilities of slag and various light, natural aggregates, such as volcanic scoria, pumice, etc., all of which are of a vesicular nature; that is, full of small nonconnecting cells which reduce weight. In pursuance of these studies it was found that certain clays or shales could be burnt so as to produce a light-weight vesicular product similar in appearance and qualities to the volcanic basalts, but more uniform in character and therefore better fitted for aggregates.

Accordingly, experimental work was started at the Bureau of Standards in the early summer of 1918 on quantity production of this material. The first working plant was a down-draft beehive kiln near Birmingham, Ala., where enough aggregate was turned out to supply the 3000-ton "Atlantus," launched in December at Brunswick, Ga. Experiments were also carried on in a portland cement rotary kiln at Ragland, Ala., and initiated at a railroad tunnel kiln at Perth Amboy, N. J., local clays and shales being used at each, but neither progressed beyond the experimental stage. Later, however, two contracts were let for quantity production for the big concrete ships under way; one to the Atlas Portland Cement Co., which makes the aggregate in cement kilns at Hannibal, Mo., and one to the Los Angeles Pressed Brick Co., which made the aggregate in dome kilns formerly used for burning brick. Both plants are now producing aggregates, the Hannibal plant supplying the ships at Wilmington, N. C., Jacksonville, Fla., and Mobile, Ala., and the Los Angeles kilns those at San Diego and San Francisco. In all, 25,000 tons of the aggregate will be required for the present Government program.

The new light-weight aggregate, as has been stated, is an artificially burned clay or shale uniformly filled with small nonconnecting cells. Speaking nontechnically, it is a bloated brick; that is, the basic clay or shale from which it is formed, when subjected to a temperature of about 1800° to 2000° in a kiln, becomes plastic and sears over on the surface, a coating being formed there which retains the gases generated by the decomposition, under heat, of the contained compounds. This expanding gas blows the brick or the clay ball full of holes and bloats it to several times its original size.

Various clays and shales are of the proper quality and consistency for such an aggregate. The material from which the aggregate is made should be rich in compounds of metallic oxides, carbon, sulphur, sodium, potassium or other equivalent compounds, some of which, when the material is subjected to heat, will either act as a flux in reducing the more refractory compounds or will give off gas at the desired time, or



LIGHT-WEIGHT AGGREGATE AS IT LOOKS BEFORE IT IS REDUCED TO PROPER SIZE FOR CONCRETING

This material was made at the Los Angeles Pressed Brick Company. Lettered brick near middle of bottom of view is of standard size.

both. The use of clay or shale containing a relatively high percentage of calcium carbonate or magnesium carbonate should be avoided, as such undesirable elements, after being subjected to a temperature sufficiently high to change their form, would be detrimental to the product. The ratio of the fluxing constituents to the nonfluxing constituents can vary within wide limits, but ratios indicating fusibility at comparatively low temperatures may be commercially preferable.

Such material is widely distributed, having been found in Alabama, New Jersey, Missouri, New York and California, and used commercially in the production of aggregates in those localities. An analysis of a typical clay or shale of which such aggregate is made is as follows:

	Per Cent.		Per Cent.
S_iO_2	60	SO_3	1
Fe_2O_3	8	CO_2	2
Al_2O_3	19	Alkalis	3
CaO	1	Water	5
M_gO	1		
		Total	100

Such composition is found both in shales and clays. Both can be used in the manufacture of the aggregate, although the process of manufacture is slightly different. Either one weighs about 100 lb. per cubic foot in its natural state.

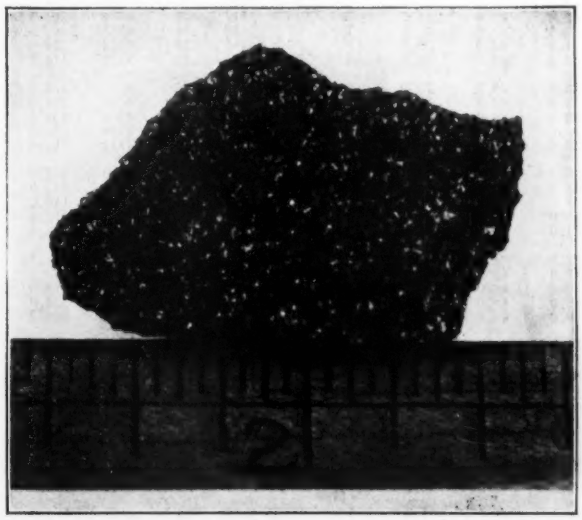
In general, in the production of the aggregate, the raw shale or clay must first be reduced by means of suitable crushers or disintegrators to a fineness so that all of it will pass through about $\frac{3}{16}$-in. openings. The purpose of this reduction is to obtain uniform texture and to prevent striations or laminations which might otherwise result in the finished material. It is then burned in a kiln, according to either the wet or dry process as noted hereinafter, is taken from the kiln either in large balls or in the bloated brick, and is then crushed to the required sizes for the aggregate which, in the concrete-ship work, is not larger than passing through a $\frac{1}{2}$-in. round opening.

The aggregate burned in the stationary brick kilns is prepared as an ordinary brick for the burning. Such a product used on the Brunswick ship was made at the brick plant of the Copeland-Ingles Shale Brick Co. at Alton, near Birmingham, Ala. This material was burned in an ordinary type of down-draft dome brick kiln. The raw material, which was a shale, was prepared as for common, stiff-mud brick, and after drying to a less degree than is the practice for the production of common brick, was placed in the kiln, set rather close in columns, leaving space for swelling, and fired rapidly. The resulting product was more or less oxidized on the surface, and lacked the uniformity possible by other methods of burning. However, most of the product was quite satisfactory. The bricks, when sufficiently cool, were taken from the kiln, crushed and screened. The coarse aggregate was that which passed the $\frac{1}{2}$-in. screen and was retained on the $\frac{3}{16}$, the fine aggregate that passing the $\frac{1}{16}$-in. screen to dust. The tests of the concrete made from this aggregate are given in Table III. Local coal was used for the fuel in the kilns.

While burning the aggregate at Alton, experiments were also made in burning the same material in a rotary kiln at the plant of the Coosa Portland Cement Co. at Ragland, Ala. In the experiments, the shale from Alton and the shale from the cement company's land were both used. There was practically no difference in the products of the two materials, neither was there much difference in the analysis of the shales. In this experiment the shale was prepared by passing it through Fuller mills and then directly to the kiln in the form of both a dry powder and a slurry. Bricks, also, were made at Alton and shipped to be burned in the rotary kiln, with quite satisfactory results. From the experiment, though it was not extensive enough to establish the fact, it would seem that somewhat better results might be expected from the use of a slurry than from the use of a dry feed. Some very excellent material was produced during this experiment, made in an ordinary cement kiln 8 ft. in diameter by 125 ft. long, using powdered coal as fuel. None of this material was used in the ships.

Further experiments were made at certain other places, both with tunnel kilns and with ordinary brick kilns, but none of the material was used in practical work.

Later a contract was entered into with the Atlas Portland Cement Co. to produce light aggregates in its plant at Hannibal, Mo., using shale found on the property. The raw material here was reduced to a fineness of approximately 100% through a 50-mesh screen, and introduced into a large cement rotary kiln in a dry state, with powdered coal as fuel. This burned ball coming through the rotary was passed directly into a crusher while hot and sorted at the distribution end of the kiln. Crushing the material while hot and malleable produced particles of a spheroid shape with few of the sharp corners which distinguish the cold-crushed material. In this product there is a rather large quantity of extra hard, burned small particles, which are screened out before the larger particles are crushed. These hard fines weigh considerably more than the more porous product, but on account of the expense of production they are being used in the ship work. As noted in the tables and descriptions further on, they tend to increase the weight of the concrete a few pounds over that of the concrete made from the brick aggregate. The product of the Hannibal mill is now being shipped to the Atlantic and Gulf yards.



PIECE OF CRUSHED LIGHT-WEIGHT AGGREGATE SHOWS FIXTURE

The scale shown in the view is to one-sixteenth of an inch

Still later an agreement was made with the Los Angeles Pressed Brick Co. to produce the aggregate in semi-muffle and down-draft kilns, using oil as fuel. In this plant the material is pugged and mixed with water and forced through brick machines and burned as ordinary brick. There is being produced here a remarkably light and satisfactorily strong material, as shown in the data in Table IV. It is being used on the San Diego and San Francisco ships.

The aggregate as used in the concrete ships is as a rule being divided into two sizes, the coarse material, that which passes through a screen having $\frac{1}{2}$-in. round openings and is retained on the screen having $\frac{3}{16}$-in. round openings, and the fine material, that which passes through a screen having $\frac{3}{16}$-in. round openings. In the ships the concrete is mixed in the proportions of one part cement, two-thirds part fine aggregate, and one and one-third parts coarse aggregate, although in some of the yards these proportions have been changed to slightly different mixtures which are noticed in the various strength tests given herewith. The early speci-

TABLE I. COMPRESSION TESTS OF LIGHT-WEIGHT AGGREGATE CONCRETE MADE AT HANNIBAL, MO.

Tests made on 6x12-inch cylinders at mill. Mixture = 1 part Atlas portland cement, ½ part fine aggregate, 1 part coarse aggregate.
Typical sieve analysis:
Fine aggregate: Per cent. passing sieves No.

10	20	40	60	80	100
90.0	70.0	44.3	29.1	18.1	12.1

Coarse aggregate: Per cent. passing screens.

¾ In.	½ In.	¼ In.
5.0	78.0	100.0

Fine Aggregate Wt. Lb. per Cu.Ft.	Coarse Aggregate Wt. Lb. per Cu.Ft.	Water, per Cent.	Compressive Strength, in Lb. per Sq.In. Consistency Drop, Inches	Age	One Week Strength	Age	One Month Strength	Wt. of Concrete Green Lb. per Cu.Ft.
70.1	41.8	22.6	8	7	2510	28	4303	115.0
68.0	42.0	21.9	9	7	2584	28	4199	115.5
76.0	44.0	21.5	8	8	2545	28	3554	115.0
74.0	46.0	22.0	8	7	2428	28	3751	116.5
74.0	47.0	20.9	7	8	2313	28	4173	116.0
72.0	47.0	21.1	9	7	2313	28	3806	117.5
69.0	42.0	22.2	9	7	1793	28	3246	115.5
73.0	44.0	22.3	9½	10	2062	28	3290	117.7
72.0	42.0	22.0	9		1863	28	3567	116.0
72.0	43.5	21.9	9		1766	30	3703	115.0
68.0	43.0	20.6	7	11	2552	28	4718	114.0
68.6	45.0	19.3	7½		2485	28	5059	114.5
63.0	42.0	22.2	9	11	3192	30	3920	114.0
66.5	43.2	22.2	9½	9	2910	28	3852	114.0
67.0	43.0	21.2	8	10	3117	28	4495	114.5
68.0	43.0	21.5	7	7	2370	28	4252	112.6
71.0	44.0	20.7	7	7	2941	28	4664	114.0
71.0	44.0	20.5	9	7	3074	28	5128	114.5
70.0	45.0	20.4	8	7	2844	28	4982	116.0
71.0	43.5	22.0	8	7	2529	28	4055	114.0
70.0	45.0	21.2	9	9	2893	28	4333	117.0
70.0	44.0	21.4	8	7	2473	28	3735	116.0
68.0	44.0	21.0	8	7	2532	28	4732	114.0
64.0	40.0	21.0	7½	7	2678	28	4808	112.0
64.0	38.0	22.0	8½	7	2125	28	4112	112.0
68.0	41.0	22.2	8	8	2360	28	3669	114.0
68.0	45.0	22.0	8½	9	2394	28	4299	112.6
73.0	45.0	22.0	9	7	2415	28	4370	115.3
72.0	46.0	22.0	8½	7	2415	28	5397	115.8
71.0	46.0	22.0	8	7	2783	28	4703	116.5
70.0	45.0	22.0	9½	8	2959	28	5358	115.0
69.0	44.0	22.7	10	8	2761	28	5096	114.0
70.0	44.0	22.0	9	8	2694	28	4104	114.2
70.0	44.0	22.0	9	9	2970	28	4344	114.5
69.0	44.0	23.0	9	7	2431	28	4562	114.0
70.0	50.0	22.8	9	7	2491	28	4561	114.2
71.0	45.0	22.0	8½	7	2780	28	4857	116.0
71.0	44.0	22.1	9	7	2429	28	4531	114.4
68.0	43.0	22.0	9	7	2605	28	4587	114.0
70.5	46.0	22.1	9	7	2557	28	4858	114.2
69.0	43.0	22.0	8½	7	2332	28	4602	114.0
67.0	42.0	22.0	8	7	2617	28	5049	114.0
67.0	43.0	22.7	9½	7	2423	28	4742	113.5
67.0	43.0	22.4	9	8	2848	28	4194	112.7
68.7	43.5	22.0	8	8	2772	28	4528	112.6
68.0	44.0	22.2	9	7	2374	28	4972	113.1
72.0	44.0	22.0	8½	9	2454	28	3897	113.9
69.0	43.5	22.0	9	7	2439	28	4510	.....
67.6	42.5	22.0	9	8	2840	28	4601	112.1
70.2	45.5	22.5	8	7	2638	28	4378	114.0
76.0	45.0	23.5	9	7	2288	28	4489	113.2
74.0	45.3	22.9	9	7	2325	28	4179	112.8
68.0	46.0	22.0	8	9	2758	28	5141	112.8
70.0	45.0	22.0	8½	7	2407	28	5061	114.0
68.0	43.0	22.9	9	7	2284	28	4596	112.5
70.0	43.0	23.0	8½	7	2517	28	4233	112.7
68.0	42.0	22.5	9	7	2257	28	4729	113.0
68.0	43.0	2.6	9	8	2316	28	4964	112.8
68.0	42.0	21.8	10	7	1916	28	4048	112.6
72.0	43.0	23.0	9½	8	2186	28	4271	112.5
70.0	41.0	24.0	10	7	2173	28	4529	113.0
Average							4,417	114.2

TABLE II. COMPRESSION TESTS ON LIGHT-WEIGHT AGGREGATE MADE AT HANNIBAL, MO.

Tests made on 6x12-inch cylinders poured with ship at yard.
Portland cement passing 90% through 200-mesh sieve.
Consistency drop averages 9 inches.

Yard and Ship	Age, Days	No. of Cylinders	Mixture	Weight per Cu.Ft.	Compressive Str., Lb. per Sq.In.	Modulus of Elast.
Wilmington, 1562	28	9	1:1:1	118.5	4744	3,030,000
Wilmington, 1560	28	11	1:1:1	116.0	5169	3,105,000
Mobile, 1716	28	18	1:1:1	118.9	5591	3,306,000
Mobile, 1715	28	20	1:1:1	117.1	5157	2,997,000
Jacksonville	7	3*	1:1:1	116.0	5158	.....

* Tests on cubes.

fication for the concrete was that the 1: ¾: ¾ mixture with sufficient water to produce a consistency drop of 9 in., according to the test noted in Mr. Davis' paper in *Engineering News-Record* of Mar. 27, 1919, p. 603, shall develop in seven days a minimum strength of 2500 lb., using standard American portland cement. In the ship the special fine-ground cement, passing 90% through the 200-mesh screen, is being used. The tests, as given in the accompanying tables, indicate that the 2500 lb. would be a safe minimum for the seven-day test, with 4000 or even 4500 lb. per square foot for the 28-day test. The early specifications for the weight of the aggregate were that the coarse material should not weigh more than 37 lb. per cubic foot. This is somewhat lighter than the average material produced.

Tests are given in the various tables herewith. Table I represents the mill test of the concrete aggregate made at Hannibal, mixed to a 1: ¾: 1 proportion. These are compression tests on 6 x 12-in. cylinders and represent material shipped to Mobile, Jacksonville and Wilmington. The screen analysis of only one of the aggregates is given, but this is fairly representative of the group. From this it will be seen that the fine aggregate made at Hannibal averages about 67 lb. per cubic foot in weight and the coarse aggregate about 43 lb. per cubic foot, that the seven-day compressive strength is about 2500 lb. per cubic foot, the 28-day compressive strength averages 4417 for 61 tests, and that the weight of the concrete for the same number of tests is 114.2 lb. per cubic foot. The low compression for 28 days is 3246 and the high 5397, with only two testing below 3500 and eight above 5000. The low weight for the wet concrete is 112 lb. and the high 117½ pounds.

TABLE III. COMPRESSION TESTS ON LIGHT-WEIGHT AGGREGATE MADE AT ALTON, ALA.

Tests on 6x12-inch cylinders poured with ship at yard.
Portland cement passing 90% through 200-mesh sieve.
Consistency drop averages 8½ inches.

Mix	Age	No. of Spec.	Wgt. Lb. Cu.Ft.	Compression Lb. Sq.In.	Modulus of Elast. at 1500 Lb. Sq.In.
1:¾:4/3	1 mo.	2	115.7	3042	2,866,000
1:¾:4/3	1¼ mo.	14	114.2	3774	2,608,000
1:¾:4/3	60 days	14	111.6	3836	2,398,000
1:2	1 mo.	2	128.1	4375	3,080,000
1:2	1¼ mo.	5	122.0	3740	2,608,000
1:2	60 days	15	121.0	4493	2,733,000
1:1	1 mo.	3	124.3	4055	2,720,000
1:1	60 days	2	125.2	6195	2,355,000
1:¾:4/3	59 days	4	112.0	4425	.....
1:¾:4/3	35 days	3	124.0	4280	.....

Table II gives the result of cylinders taken from the actual pourings of the various Atlantic and Gulf ships of concrete made with the Hannibal aggregate. From these it will be seen that the 28-day test of a 1:1:1 concrete made up of the aggregates of the sizes noted before averages well above 5000 lb. per square inch, and that the weight is somewhat higher than the weight of the mill-tested concrete of the 1: ¾: ¾ mixture, running around 116 lb. per cubic foot. This, however, is the weight immediately after pouring, and other tests have shown that this decreases 3 or 4 lb. in the 28-day test. Table III shows the tests of various proportions and various ages of the dome-kiln aggregate used in the "Atlantus" at Brunswick, Ga. The strengths are not quite as high as the others given, but the weights are about the same. Tables IV and V give the results of some of the tests of the Pacific Coast aggre-

TABLE IV. COMPRESSION TESTS OF LIGHT-WEIGHT AGGREGATE MADE AT LOS ANGELES, CALIF.

Tests made on 6x12-inch cylinders mixed by hand for the test. Mixture 1 part portland cement ground to pass 90% through 200-mesh sieve, 1 part fine aggregate, 4·3 part coarse aggregate. Typical sieve analysis:

Fine aggregate. Per cent passing sieve No.

10	20	30	40	50	80	100	200
93.4	74.2	64.0	57.4	54.6	40.4	35.4	25.4

Coarse aggregate. Per cent passing sieve:

¾-in.	½-in.	1/10-in.
98.4	80.4	4.6

Fine Aggregate Wt. Lb. per Cu. Ft.	Coarse Aggregate Wt. Lb. per Cu. Ft.	Consistency Drop in Inches	Water, per Cent.	Compressive Strength, Lb. per Square Inch 7 Days	Compressive Strength, Lb. per Square Inch 28 Days	Wt. per Cubic Ft. in Lb Green	Wt. per Cubic Ft. in Lb 7 Days	Wt. per Cubic Ft. in Lb 28 Days	Yield per Cent.
61.5	41.5	9	20.4	2563	3676	111.0	106.5	107.5	147.0
61.0	41.0	9½	23.8	2765	....	112.0	108.2	.....	151.0
57.5	37.2	9½	22.7	3035	....	113.5	108.2	.....	143.2
61.3	37.5	9	22.4	2641	....	113.0	106.2	.....	149.5
60.3	39.7	8½	21.4	2816	....	113.0	109.5	.....	145.5
58.8	38.8	9½	22.[illegible]	2682	....	111.5	107.3	.....	145.5
62.8	46.0	9½	17.7	2890	....	109.5	108.7	.....	150.1
57.5	42.5	9	20.9	2794	....	107.5	107.2	.....	150.5
61.3	40.0	9	23.5	2480	....	113.5	108.5	.....	147.5
60.0	42.8	9½	21.3	2861	....	112.0	108.7	.....	145.5
62.8	45.6	9½	23.1	3015	....	116.0	109.0	.....	154.5
69.0	44.3	9½	22.8	2639	....	114.5	109.6	.....	158.6
63.0	41.5	9	22.3	2575	....	112.0	....	.....	145.5
61.7	38.0	9	21.1	3625	....	113.0	108.6	.....	145.5
66.6	39.0	9½	23.6	3216	....	113.0	109.6	.....	145.5
64.0	39.5	9	23.8	3315	....	113.5	109.1	.....	145.5
55.6	38.0	9½	23.6	....	....	111.0	.....	.....	143.3
56.8	39.0	9	21.1	....	....	111.0	.....	.....	150.6
58.4	40.3	9	23.2	....	....	110.5	.....	.....	145.1
Average.....				2867		112.1	108.3		

NOTES—The per cent. of water is based on the weight of dry material, including cement and aggregates.

The yield as used is the volume of concrete divided by volume of coarse aggregate.

Aggregates were wet when made into concrete.

TABLE V. COMPRESSIVE TESTS OF LIGHT-WEIGHT CONCRETE USED IN CONSTRUCTION OF HULL 1662, SAN FRANCISCO SHIPBUILDING COMPANY

MIX

1 part reground cement.
½ part fine aggregate (1/10 in. down).
1½ part coarse aggregate (¼ in.—1/10 in.).

Consistency Drop, In.	Age Days	Compressive Strength Lb. per Square Inch	Weight per Cubic Foot, Lb.
8½	7	3040	104.2
9½	7	2677	107.5
9	7	2872	105.9
9½	7	2637	104.1
9½	7	2681	107.6
9½	7	2751	109.3
9½	7	3393	104.9
9½	7	3447	108.4

Last four mixes have 1 ½% diatomaceous earth by weight of cement, added to overcome the tendency of the concrete to segregate.

gates. In experimental mixtures not noted here the material dropped as low as 92 lb. per cubic foot in weight, and averaged below 100 lb. Tests on the concrete as poured in the ships show that while the weight is not quite so low it is somewhat less than with the Eastern aggregates and the strength is satisfactory.

There has not been sufficient time to make long-time tests of the light-weight concrete, but a few such tests, noted in Table VI, show values as high as 7200 lb. at 3 months, and for the standard consistency of the other tests a strength of 6483 lb. for the same period.

Some concern is occasionally expressed as to the permeability of a concrete made with this material. A number of tests have been made, and they all show that such a concrete is as low in absorption and in permeability as concrete made with an apparently more dense aggregate. The material is not porous. While full of holes, it must be remembered that they are nonconnecting holes, so that there is no reason why water should pass through such a concrete, assuming that the aggregate itself is of a dense material. Very few strength tests on the aggregate itself have been made. Recent tests at the University of Pennsylvania laboratory show that in 1-in. cubes it has an average compressive strength of about 1500 lb. per square inch, with values in test ranging from 1000 to 2500 pounds.

Commercial production of the aggregate except for the Government ships has not been started, though there are prospects that one or both of the Government contractors will continue production after the ship requirements are satisfied. There is a company in Kansas City, under the direction of Stephen J. Hayde, which is manufacturing a somewhat similar product known as Haydite. This material was used in the concrete superstructure of the freight car recently exhibited in Chicago. Haydite was developed some years ago as the aggregate for sand-lime brick and is produced in a vertical kiln.

TABLE VI. THREE-MONTHS COMPRESSION TESTS OF LIGHT-WEIGHT CONCRETE

Commercial cement with a variation of workable consistencies. Mix=1:2/3:4/3

Consistency Drop, inches	Compressive Strength lb. per square inch
5½	7285
7	6560
9	6483
10½	6180

The technique of the manufacture of the aggregate is necessarily complicated, as the value of the resulting product depends so much on the quality and moisture content of the raw material, the nature of the preliminary treatment, the degree of heat, and many other details. There is no claim that perfection has been reached in the brief time in which experiments and quantity production have been under way, but the aggregate is uniform and satisfactory in quality and there is every hope that its commercial manufacture is possible. Costs today are not consistent, and are not therefore of much use to those contemplating the use of the aggregate for structural purposes. It seems, however, that the aggregate should be produced at the mill for $3 or $4 per cubic yard, which will weigh in the crushed state about as shown in Table I and in the ball or brick, uncrushed, about 60 lb. per cubic foot.

The studies, tests and production of this aggregate have all been carried out under the direction of Rudolph J. Wig, head of the concrete ship section of the Emergency Fleet Corporation, with C. W. Boynton and W. D. Richardson, specialists in immediate charge of the work. Credit should also be given to A. V. Bleininger, ceramic chemist of the Bureau of Standards, for laboratory burns of various clays to determine suitability for the purpose.

Will Name Bridges After War Heroes

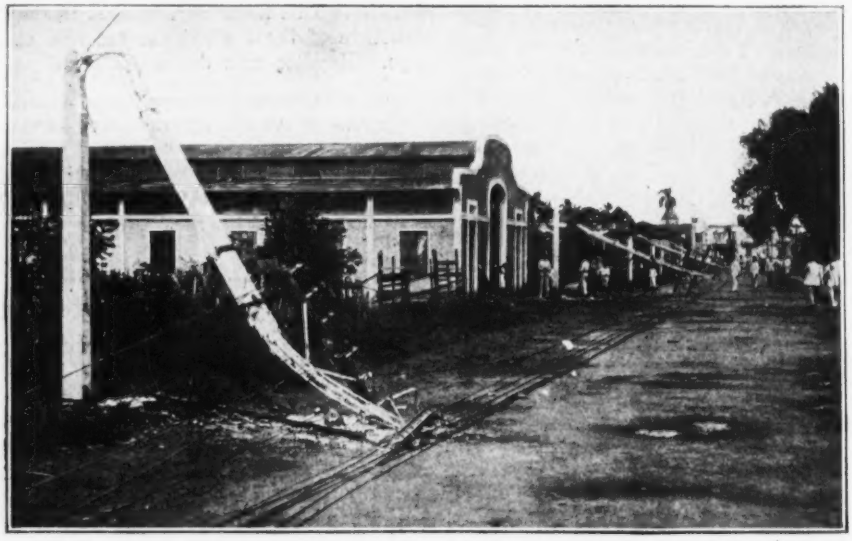
As memorials to soldiers who lost their lives in France, the City of Hutchinson, Kan., is to name some new concrete bridges just being built after specific men. A granite cornerstone inscribed with the soldier's name, regiment, and military record will be placed at each end of the bridge. Five bridges have been so designated for the present year.

Effect On Structures of Recent Porto Rico Earthquakes

Wood Frame Proves Safest for Buildings, With Well-Built Reinforced Concrete Next, But Articulated Construction Is Poor

By M. L. Vicente and C. F. Joslin
Professor of Civil Engineering and Assistant Professor of Physics, Respectively, College of Agriculture and Mechanic Arts, Mayaguez, P. R.

EARTHQUAKE-RESISTING construction, which is a decided necessity in some sections of the world, can best be studied from the behavior of existing structures in a serious earthquake. Opportunity has been afforded the authors during the past six months to observe closely the effect of the successive earth shocks to which parts of Porto Rico were subjected in that period. On the calm and typically hot tropical morning of Oct. 11, 1918, there occurred in western Porto Rico a severe earthquake shock, lasting some 50 sec. and accompanied by distinct subterranean rumblings. All communication with the outside world and with the rest of the island was temporarily cut off, the property loss was about $3,000,000 throughout the island, while the loss of life was nearly fourscore. At the time of the first earthquake the writers were in their classrooms in the engineering building of the college in Mayaguez. This building, of modern reinforced-concrete construction, did not collapse, but all chemicals were thrown violently to the wooden floors, and soon the building was in flames.



LINE OF CONCRETE POLES BROKEN—ONE-STORY CONCRETE BUILDING INTACT

This first earthquake was followed shortly by a tidal wave some 15 ft. high which swept in from the sea and mainly concentrated itself at the head of the harbors of Mayaguez and Aguadilla. This wave destroyed several hundred huts along the shore, in which many of the poorer classes lived. The monetary damage was slight, but over a thousand persons were rendered homeless by the wave, which aroused so much terror among the lower classes that they started in droves for the highest nearby hills.

The first earthquake was followed by sharp quakes which occurred every few hours for a full week. It was the continual fear and uncertainty as to the outcome of these lesser quakes which kept the inhabitants in a state of terror and made it most difficult to obtain men who would help in the necessary reconstruction work. At midnight, Oct. 25, two weeks after the first earthquake, the western part of the island was visited by a second severe earthquake. There was but little property damage done by this shock, mainly because most of the damage had been done that could be done. Two and a half weeks after this second quake occurred the third severe earthquake, on the afternoon of Nov. 12. This earthquake was most discouraging; it took the heart out of many men who had considered the earthquakes as over and who had practically decided to rebuild. There have been a multitude of short, sharp tremblings ever since the first earthquake in October, decreasing in intensity, duration and frequency, but occasionally punctuated by more severe jolts of longer duration. At the present writing, Mar. 18, 1919, there have been no sharp tremblings of any kind for over 10 days.

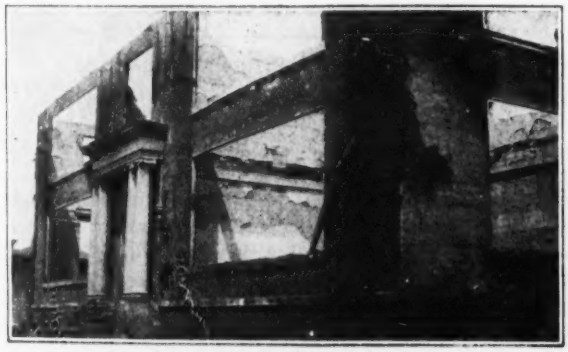
The cause of the earthquake was left for seismologists to fathom. The most generally accepted belief is that the first earthquake was caused by the sudden falling or slippage of great masses of rock under the ocean surface in the Mona Passage, which lies between the western coast of Porto Rico and eastern Santo Domingo. Inasmuch as the cities of Mayaguez, Anasco and Aguadilla, which were most severely hit by the earthquake, are all on the western coast, and as the earthquake diminished in intensity and effect toward the eastern end of the island, this theory sounds quite plausible. The later earthquakes were apparently caused by further slippage and settlement of large rock masses in the same locality.

The writers were appointed by the assistant commissioner of the interior to act with the municipal engineer in an endeavor speedily to make the city safe for life and property. For two and one-half weeks the committee was busy in dynamiting dangerous walls and towers, erecting temporary bridges, making temporary roads and shoring up property wherever feasible. Opportunity was obtained in this work for observing certain effects of the earthquake on various structures.

The damage done in Mayaguez was pitiable, because so much of it could have been avoided. The great majority of houses, except in the heart of the city, are of simple wood construction, an absolutely safe type of structure in earthquake regions. The wooden house creaks, rocks and sways, but it does safely resist the most severe earthquakes. Shortly after the first earthquake it was very evident that no one felt secure for the night unless he slept in a tent, out of doors, or in a wooden house.

Another type of construction common here is a one-story native brick store or dwelling. We have not seen one such building which has satisfactorily withstood the earthquake. Most of them went completely to pieces. There are several reasons for the universal failure of brick structures. The bricks used here are made locally in almost prehistoric fashion. Yokes of oxen are made to work the clay with their hoofs; the bricks are hand-made and burnt in crude kilns. These bricks are naturally very porous, of low compressive strength and of varying poor quality. The native brick is 1 in. thicker and 1 in. wider and longer than the typical American brick. In laying brick, joints ¾ in. thick are often found in what is considered first-class brickwork. The mortar is generally of lime and sand—rather dirty, smooth sand. Failures in brick structures were often due to lack of coherence between bricks. Very often in tearing down walls the bricks could be lifted loose by hand.

It was continually noticed that brick walls supporting roof or floor beams held up better than unloaded walls. The common type of overhanging brick cornice is an unwise design in earthquake regions. Save in rare cases, these cornices broke off and fell into the street, sometimes carrying the lower wall with them in their fall. Brick arches of all types were subject to failure. To see an intact brick arch of any type was unusual. In nearly every brick arch seen or inspected the key had either dropped several inches or had dropped out entirely. Much of this was due, of course, to the poor



CONCRETE WALLS OF COLLEGE BUILDING INTACT BUT CRACKED AT INTERSECTIONS—FIRE GUTTED BUILDING

quality of brick and mortar used. In general, it was evident that walls parallel to the direction of the earthquake waves, northwest to southeast, were more seriously damaged than were walls running perpendicular to the direction of these waves.

A number of buildings were made of wooden framing, filled in with brickwork. The brickwork had to be removed, but the woodwork was undamaged and was used for framework in rebuilding the house of wood. Many

TYPICAL FAILURE OF KEYS IN BRICK ARCHES

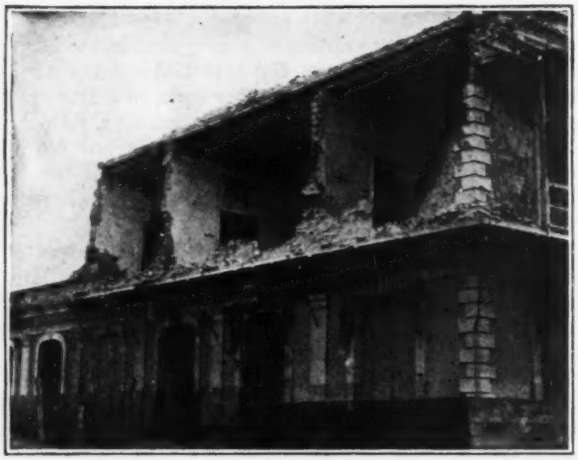
instances were noticed where floor and roof timbers embedded in brick walls had practically rotted away at the ends to within ½ to 1 in. of the edge of the support. In fact, this condition was so typical in the larger dwellings that the authors felt that had not the earthquake exposed these rotting timber ends, in a few years some of the floors would, under a normal load, suddenly have collapsed, with loss of life and property. No attempt had apparently been made to protect the wooden beams in any cases against the effects of the alternate wet and dry seasons.

Concrete, when properly designed and inspected, makes a dependable construction. The largest building in Mayaguez, a four-story reinforced-concrete structure belonging to the Redemptionist Fathers of the Roman Catholic Church and built by an American contractor, withstood all the earthquakes. It was used as a temporary hospital for those injured in the earthquake. It was noted in this building that the plastering on the walls was in some cases from 1½ to 2 in. thick where presumably the walls had been cast out of plumb. Wherever the plaster was over ½ in. thick it cracked loose from the concrete wall during one of the three earthquakes. This building had doors leading from the building onto the balcony from the middle of each floor. About 2 ft. above each door, and midway between the top of the door and the bottom of the door immediately above it on the floor above, were left ventilation holes in the concrete wall some 10 in. in diameter. The location of these holes was unfortunate. The concrete cracked from the top of one door to the ventilation hole, from the upper edge of the ventilation hole to the bot-

tom of the door on the next floor and thus through the door to the next ventilation hole. In other words, as these doors were all in the same vertical line from the top of the building to the bottom, and as the ventilation holes were also in the same vertical line, as a result of the earthquake cracks have connected these openings and the building has practically been divided into two parts along this center line. In general, however, this building stood the earthquake in good shape, and no material damage was done anywhere. It stands as conclusive proof that well constructed reinforced concrete can stand up in earthquake territory.

A number of buildings constructed of so-called reinforced concrete collapsed at the first severe shock. These buildings were poorly designed, were slighted on cement and carelessly erected. The most flagrant case was "La Hababera," a large two-story cigar factory. The walls were 6 in. thick and reinforced with vertical round ½-in. rods spaced about every foot. The concrete could be easily picked apart with no danger of dulling the end of the pick. The sand used was obviously too smooth and unwashed. The absence of cement was conspicuous. The collapse of this structure was a lesson to everyone who saw it, and local contractors will be more careful henceforth in choosing their aggregate. Some fifty persons were killed in this building.

The electric light wires for the city were carried on reinforced-concrete poles, some 30 ft. high and tapering from a 9 x 9-in. cross-section at the bottom to a 6 x 6-in. section at the top. A great many of these poles broke completely in two some 15 ft. from the ground. This was due in many cases to large masses of wall falling on the tense wires. It seems that the reinforcing was somewhat of a handicap, because the steel separated the inside core from the outer part of



TYPICAL FAILURE OF SECOND-STORY BRICK WALL AS A UNIT

the section of the pole. The rods were ½ in. square twisted rods, with hoops every foot vertically. As the sand was not particularly clean, the bond to the steel was poor, and the reinforcing merely served to prevent the concrete inside the steel reinforcing cage from properly bonding with the outer concrete. A hollow circular pole would have been more sturdy.

The authors are fully convinced that reinforced concrete and wood are suitable materials for construction in earthquake countries. There are no structural steel buildings in this section, and no opportunities were therefore afforded for observing the behavior of this construction. In concrete work all contractors in the western part of Porto Rico are handicapped by the

ROOF OF BRICK LAID FLAT ON 1 x 2-INCH WOOD STRIPS AND JOINTED WITH GROUND CORAL

want of sharp, clean sand. In San Juan the ocean sand is fairly reliable, but on the western coast sea sand is entirely too smooth and fine. The other alternative material is the river sand, which is rather coarse, very dirty and not very sharp. The stone is river stone and gravel, strewn with old brick bats. For these reasons the use of the smooth bar for reinforcing work is highly undesirable in this section of the island.

The greater part of the loss of property in the earthquake and practically all the loss of life could have been avoided by reliable construction so far as materials, workmanship and design are concerned. All concrete walls should be well tied by horizontal reinforcement at all corners and intersecting walls. Continuous stretches of wall of any type are unwise without tie walls or other precautions against vibration.

Calls on Water Consumers Analyzed

In one year the water department of Oak Park, Ill., made calls equivalent in number to 88.7% of the 7683 accounts it has on its books. Of the 6802 calls, 13.34% were to turn on services for new customers, 12.25% were calls on delinquents, 11.79% to shut off services and close account, 8.46% because of meters not registering, 7.2% for special reading of meters, 6.45% to shut off water-supply from vacant houses, 5.35% to investigate leaks on account of high bills, 4.98% for periodical tests, 4.68% for meter leaks, 4.45% to investigate miscellaneous complaints, 3.38% to read meter for new tenants, 2.12% to locate service boxes, 2.16% to turn off water from delinquents, 2.1% on account of frozen meters, 1.81% for repairs made by laborers, 1.54% for "no water" complaints, 1.5% to check consumption, 1.37% to re-read meters, 1.37% for service leaks, 0.87% to inspect meter boxes, 0.62% on consumers' call for test, 0.60% for special shut-off at request of consumer, 0.38% to repair fire plugs, 0.25% to inspect premises found without meter, 0.29% to repair meter dials, 0.22% to reset incorrectly installed meters, and 0.1% for repairs made by inspectors.

Prices Yesterday, Today and Tomorrow

An Analysis of the Factors—Scarcity Demand, Advance in Wages and Inflation—Responsible for the Present High Price Level

A paper by O. P. Austin, statistician of the National City Bank of New York City, read before the Editorial Conference of the New York Business Publishers' Association, Apr. 11, 1919.

THE purpose of this address, as implied by its title, "Prices Yesterday, Today and Tomorrow" is an attempt to look into the future and determine, if possible, the probability as to the course of prices. That there have been great and continuous advances during the war period we are painfully conscious, and in the five months since the cessation of hostilities we have failed to experience the reduction which some had fondly hoped would come with the close of the war. In a few instances there have been slight reductions but in others there are still advances, and the index figures on foodstuffs in New York today are actually higher than those on Nov. 5, when the whole world so joyously welcomed the apparent termination of the great conflict which had raged for fifty-one months.

To attempt to determine what is likely to happen in the future we must try to find the cause of the things which have happened in the past, and also to see whether this cause is or is not likely to continue in the near future. When prices began to advance in the opening of the war, we could readily see that the upward movement was due to the urgent demand for the food and raw material required by the enormous armies which had been put into the field, and this cause has been designated the "scarcity demand," but when we found the advance extending to many articles in which there was no scarcity and which were not used by the armies or utilized in the manufacture of their requirements, we began to realize that a part of the advance must be due to some cause other than mere war or scarcity demands.

Edgar Crammond, the distinguished British statistician and economist, in an address before the London Institute of Bankers on Mar. 26, 1919, stated that the three facts which would tend to make the fall in prices a very gradual one are: (1) the vast increase in the amount of paper money; (2) the huge increase in the amounts of public debts of the belligerents; (3) the determination of labor to maintain wages and improve the standard of living.

Price Advances World-Wide

Raw silk, for example, for which the war made no special demand and which was produced on the side of the globe opposite that in which the hostilities were occurring advanced from $3 per pound in the country of production in 1913 to $4.50 per pound in 1917, and over $6 per pound in the closing months of the war. Manila hemp, also produced on the opposite side of the globe and not a war requirement, advanced in the country of production from $180 per ton in 1915 to $437 per ton in 1918. Mechanically ground wood pulp, not a war requirement, advanced as our publishers are aware, from $14 per ton in the opening months of the war to $35 per ton in the opening months of 1916, and the grade known as "chemical bleached" advanced from $50 per ton at the beginning of the war to $160 per ton in January, 1919. Goatskins, from China, India, Mexico and South America advanced from 25 cents per pound in 1914 to over 50 cents per pound in 1918 and yet goatskins were in no sense a special requirement of the war. Pig tin, produced by Chinese labor in the Malayan Peninsula and the Dutch East Indies and not to a very great extent a war requirement sold in the country of production in 1914 at 30 cents per pound and in the same markets at 75 cents per pound in the closing weeks of the war. Sisal grass produced in Yucatan advanced from $100 per ton in 1914 at the place of production to nearly $400 per ton in 1918, and Egyptian cotton, a high-priced product and thus not used for war purposes, jumped from 14 cents per pound in Egypt in 1914 to 35 cents per pound in 1918. Even the product of the diamond mines of South Africa advanced from 60 to 100 per cent in price per carat when compared with prices existing in the opening months of the war.

The prices which I have quoted to you are in all cases those *in the markets of the country in which the articles were produced* and in most cases at points on the globe far distant from that in which the war was being waged. They are the product of countries having a plentiful supply of cheap labor and upon which there has been no demand for men for service in the war. The advance in the prices quoted is in no sense due to the high cost of ocean transportation since they are those demanded and obtained in the markets of the country of production.

Labor Doubled in Price During War

Why is it that the product of the labor of women and children who care for silk worms in China and Japan, of the Filipino laborer who produces the manila hemp, the Egyptian fellah who grows the high-grade cotton, the native workman in the diamond mines of South Africa, the Mexican peon in the sisal field of Yucatan, the Chinese coolie in the tin mines of Malaya, or the goat-herd on the plains of China, India, Mexico or South America has doubled in price during the war period? The articles enumerated were in no case for use in the war and the prices are those in the country of production and thus not due to the increase in ocean freights or dangers of over-sea transportation. The advance has been general, world-wide. In a few articles in which an over-production was occurring in which the demand fell below normal the advance was not so strongly marked but there is scarcely an article in the long list of those entering world markets in which there has not been an advance, no matter how distant its place of production from that in which the war was occurring or how little the war's demands for it or for the labor by which it was produced.

Surely there must have been some general underlying causes for this world advance, this simultaneous demand by people of all classes and in all parts of the globe for higher prices for their products irrespective of their relation to war requirements. While we may be willing to accept the immediate demands of the war as a partial explanation of the advance in the prices of foodstuffs and certain manufacturing material and manufactures we must look farther for the cause of the similar ad-

vance in articles upon which the demands of the war could have had no direct bearing. It is true that a marked advance in the price of one important class of products does cause an advance in the prices demanded for other articles which must be exchanged for those in which the advance has already occurred, but it does not seem probable that the advance due to scarcity of a comparatively few of the world products required for war could have been the chief cause of the doubling of prices in practically every article produced in every part of the world, many of which had not the most remote relation to war requirements.

Underlying Causes

Apparently the principal causes of the advance in prices during the war were, stated in their chronological order, first, "scarcity demand"; second, the advance in wages presumably due to the increased cost of living and demand for labor, and, third, the large increase in world circulating media, or to put it in a single word, "inflation." Prof. A. C. Miller, member of the Federal Reserve Board, an authority whose views are entitled to high consideration, in a recent address before the American Academy of Political and Social Science named as the two chief causes of the advance in prices, "scarcity demand" and "inflation," adding that "there is so much evidence of an artificial abundance of money in comparison with the things that are purchasable by it that the abundance of money must be credited *with at least* an equal influence in explaining the high prices which have prevailed."

What were the articles for which the war created a scarcity demand? Food, clothing, transportation facilities, and material for the battlefield. How much did it add to the world's demand for these articles? Of course, the percentage of increase in demand for strictly war materials was very large, but was there really as great an increase in demand for other materials, food, clothing, and transportation facilities as we are accustomed to imagine? Let us assume that the number of people participating in the war was forty million, which is probably more than those in the field at any one time. Do we realize how small a share those forty million were of the world's consuming population? Less than two and one-half per cent. We think of forty million as a large number of people to feed, and so it is, but it must be remembered that the number of people in the world who must be fed and clothed and supplied with transportation facilities every day of the year is 1,800,000,000 or forty-five times as many as the highest number in the military service at any time during the war. Of course the soldiers were better fed than are many of the people in certain sections of the world, but even if their per capita consumption was four times as much as the average it would still represent but a small percentage of the world's daily food consumption. And it must be further remembered that all these forty million people in the armies had been consumers of food before the beginning of the war, not to quite as great an extent perhaps as after entering the activities of the military service, but it cannot be assumed that the war added forty millions to the world's consumers of food and clothing. Nor can it be properly assumed that the withdrawal of these millions from the industries actually reduced to that extent the world's producing power, for four millions of these were already in the military service and the places of the other thirty-six million were to a considerable degree filled by others who had not been up to that time actively engaged as producers.

Much of the material used in preparing the supplies for the battlefield was "switched" from the usual lines of industry, for there was an immediate cessation of railway construction, building operation, and a thousand industries which formerly required manufacturing material and as a result of this cessation of activities the material formerly used by them became available for war purposes.

It thus appears on close analysis that the "scarcity demand" created by the war was not as great in food, clothing, or manufacturing materials as has been pictured, while the fact that fifteen millions are still under arms minimizes the reduction in military demands which had been expected.

One factor often mentioned in the attempt to determine the causes of high prices is the advance in wages of labor, but the fact that the increase in compensation of labor was in most cases given because of the fact that the cost of living had already advanced at least somewhat minimizes the relative importance of this factor in attempting to discover the real causes of the general world-wide advance in prices. And it must also be remembered that several million persons who had not been engaged in the industrial and business world came to the assistance of those engaged in these duties during the war.

Inflation

Where, then, shall we turn in the search for the principal cause of the general advance in prices of articles produced the world over and their relation to the demands of the war? What other cause can we find after giving due consideration to the scarcity demand, the destruction by war and the increased cost of labor? The most prominent among the possible or probable causes is the theory advanced or accepted by the historians, economists, statisticians and financiers of the world that inflation in currency is usually accompanied or closely followed by an advance in prices; and, as already indicated, so high an authority as a member of the present Federal Reserve Board, Prof. A. C. Miller, has recently declared that "the abundance of money must be credited with at least an equal influence in explaining the high prices which have prevailed."

I wonder if we do fully realize the quantity of paper money which the responsible governments of the world have put afloat since the beginning of the war. Thirty-six billion dollars. The paper money in existence in the fifteen principal countries of the world at the beginning of the war was less than eight billion dollars and at the end of the war was over forty-four billions, an increase of thirty-six billions in fifty-one months, and this does not include any of the eighty billion dollars' worth of paper currency issued by the Bolsheviki in the eighteen months of their control in Russia. Thirty-six billion dollars of new paper money added to the circulation of the world by fifteen responsible governments in a little over four years of time.

We had been inclined to charge up the advance in prices occurring prior to the war to the fact that eight billion dollars' worth of gold was turned out by the mines of the world in the twenty years following our famous gold and silver campaign of 1896. But here are thirty-six billion dollars' worth of paper promises

to pay turned out as legal tender money by fifteen responsible governments in a short four-year period.

Do we realize how vast a sum is this thirty-six billion dollars' worth of paper currency which has thus been put into circulation in such a brief time? It is more, *in its face value*, than all the gold and all the silver turned out by all the mines of all the world in the 427 years since the discovery of America.

True, much of this paper money is now more or less depreciated in its value as compared with gold, the world's accepted standard, but the fact that it has behind it not only a certain amount of the yellow metal but also the pledge of the governments by whose authority it was issued renders it at least an accepted medium of exchange in the countries of its origin, while the fact that nearly every neutral country of the world has meantime increased its paper currency and national indebtedness, permitting its gold to pass from circulation into the vaults of its banks as a security for the paper circulation, tends to widen the field affected by this inflated currency.

In addition to these vast sums of legal tender currency turned out by fifteen responsible governments of the world, these same governments have at the same time made an even more spectacular advance in their issue of another series of promises to pay, which while not legal tender in the ordinary sense of the term, do form a more slowly moving mass of currency. By this I mean the one hundred and eighty billion dollars' worth of bonds or other forms of national obligations issued by the governments of the world in the past four years, for national debts of the world have advanced from forty billion dollars at the beginning of the war to two hundred and twenty billions at its close. And while these bonds or other governmental promises to pay money at some future date are not legal tender currency in the ordinary sense of the term they do pass current in the financial world and prove a basis upon which money may be readily obtained by their holders, and to this extent are an addition to the world's circulating medium.

Bank Deposits Greatly Increased

Still another increase in circulating media is found in the enormous growth in bank deposits, which of itself increases circulation through the increased use of checks, especially in countries such as the United States where the check forms so large a share of the daily business transactions of the country. Bank deposits in fifteen principal countries of the world have grown from twenty-seven billion dollars in 1913 to approximately seventy-five billions at the present time, the ratio of increase being about the same as that of currency.

These increases, in circulation, indebtedness, and bank deposits, while occurring chiefly in the countries participating in the war have also extended to many other countries, especially in Europe, where the six principal neutrals have during the war period increased their national debts one billion dollars, their note circulation over a billion dollars and their bank deposits by about one billion.

Thus in a short four and one-half year period world paper money has increased thirty-six billion dollars, world evidences of national indebtedness one hundred and eighty billion dollars and world bank deposits nearly fifty billion dollars. Most of this enormous increase has occurred in "uncovered" paper. The gold mines of the world have turned out less than two billion dollars' worth of the precious metal during the war period and most of the world's gold, which formed fifty-five per cent. of world circulation at the beginning of the war, has passed into the vaults of the governments or their great banks as a basis for their paper currency, and now bears a relation of but about twenty per cent. to the flood of paper money in circulation, and this proportion of gold to paper varies widely when the respective countries are compared.

If the world's historians and financiers and economists and statisticians are right in their general belief that an advance in prices usually accompanies or closely follows inflation in currency, and especially in paper currency, can we be surprised at the world-wide advance in prices which we have witnessed during the past four years in which world currency and bank deposits trebled and national debts quintupled?

Prices of Tomorrow

We come now to the third and final question, that of prices of tomorrow. May we expect a material reduction in general prices in the near future? And in trying to determine this we must see whether the causes which brought about the advance during the war period are likely to be removed.

The chief causes of the advance seem to have been the "scarcity demand," the higher cost of labor, and the increase in circulating media.

The "scarcity demand" came on the very first day of the war, for most of the countries entering that struggle found that the demand upon them would be far in excess of their supplies either of foodstuffs or military requirements, and as the weeks and months and years progressed this fact was more strongly impressed upon them.

During the closing year of the war the ammunition factories of the various participating countries were able to meet to a great extent the requirements of their own armies but in the matter of foodstuffs the "scarcity demand" still continues with little prospect of abatement at least in the near future. The number of mouths to feed in Europe has not decreased, and that continent, which has not for many years been able to produce its own requirements of foodstuffs, now finds itself with neglected soils, a disordered population and unable to return to normal production in the immediate future. In manufacturing materials, for which Europe has also been dependent upon other parts of the world, she will require abnormally large quantities at least in proportion to her attempts to manufacture, for her stocks of this class of merchandise are absolutely exhausted. In all parts of the world which have relied upon Europe and the United States for manufactures the shelves are empty and must be filled, and most of the manufacturing sections of Europe will evidently be slow in resuming the production of manufactures for exportation, and will have limited facilities for transporting or marketing them even if produced. So it seems that, although the demand for war material has terminated, the other features of the "scarcity demand" will continue at least in a somewhat modified form in the immediate future, especially as relates to world requirements of food, manufacturing material and manufactures, while developments thus far do not point to an early reduction in labor costs.

If we are right in assuming that a considerable pro-

portion of the world advance in prices is due to the enormous increase in world currency can we expect a marked reduction in prices until the cause, "inflation," is removed? Or, to put it in another form, that part of the advance caused by inflation can only be cured by deflation, by a reduction in the enormous stocks of currency which, as I have shown you, has trebled during the war, while that other form of slowly moving currency, governmental obligations, has quintupled.

Is it probable that these two forms of currency can be or at least will be reduced in the near future? The governments of the world, which were paying less than two billion dollars a year of interest on national debts at the beginning of the war are now paying and must continue to pay a total of over ten billion dollars a year in interest, and at the same time all other expenses of governments have advanced. Official estimates of the "budgets" or expense accounts of several of the principal countries for the coming fiscal year have already been announced and indicate that their necessary expenses in the first full year of after-war peace will be about four times as great as in the year preceding the war. The British budget for the next fiscal year is estimated at about six times as much as in 1913 and those of France, United States and Canada about four times as much as before the war. Present indications are that the governments of the world will be compelled to collect in taxes from their people about fifty billion dollars a year as against about twelve and one-half billions in 1913, or say a billion dollars a week as against a billion dollars a month before the war, *and* this does not include anything for "sinking funds" or other provision for reduction of outstanding debts. If this be true is it probable that the governments in those countries which have greatly increased their circulation and must now demand such enormous increases in annual payment of taxes will find it advisable or possible to reduce materially the amounts of currency available for such payments?

If the governments which have been the chief participants in the world increase of currency should fail to reduce materially that excessive supply, and if the world's demand for food, manufacturing material and manufactures is to continue at the present rate, are we justified in expecting a general reduction in prices in the near future? The question I think answers itself. There will, of course, be instances in which there will be material reductions, but in general terms the outlook for marked or rapid decline, at least in the near future, does not seem encouraging.

Typhoid in the Large Cities of the United States in 1918

Continued Downward Trend in Majority of Cities of More Than 100,000 Population — Eight Cities Under 3 per 100,000

NOTWITHSTANDING the unfavorable conditions of the war, typhoid fever continued its downward course in 1918, according to the seventh annual survey made by the *Journal* of the American Medical Association and published in its issue of Apr. 5, 1919. In 40 of the 60 cities surveyed the rate for 1918 was lower than that for 1917, and in 20 it was higher. Three cities had a rate of less than 2 per 100,000; eight were under 3. Twenty-two were below 5 and another 22 below 10. This leaves only 16 having a rate of 10 or more.

There is a general upward trend in the rates as the population of the cities increases, but as a rule each group shows a decline in 1917 compared with 1916, and in 1918 compared with 1917. Taking the 57 cities as a whole for which complete records are available, there is a constant decline year by year from 1910 to 1918, the two extremes being 19.59 and 6.23 per 100,000. It was in 1915 that the rate for the entire group went below 10.

The two cities at each extreme in 1918 were Chicago, 1.4, and Lowell, 1.8, contrasted with San Antonio, Tex., and Richmond, Va., at 54.3 and 65.3, respectively. The *Journal* in its article asks: "Will the chamber of commerce in that town advertise the typhoid rate in Northern papers, when presenting the claims of San Antonio as a winter resort?"

The accompanying tables, taken from the *Journal* already named, give all the tabular details of the results of the survey. In its editorial comment the *Journal* says it is fair to conclude that at least in many Northern cities further typhoid reduction will have to come largely through improvement in related rural and suburban conditions.

TABLE I. TYPHOID DEATH RATES IN CITIES OF UNITED STATES

Population estimates of the United States Census have been used for this and other tables. No estimates are made by the Census for Denver, Portland, Ore., Seattle and Spokane. The estimate for Washington is made by another plan. The number of typhoid deaths is given as sent to the *Journal* of the American Medical Association by local health officers and include deaths of non-residents.

(Deaths per 100,000 population)

	1918	1917	1916	Average 1911–1915	Average 1906–1910
GROUP 1: MORE THAN 500,000 POPULATION					
Chicago	1.4	1.7	5.2	8.2	15.8
Boston	2.5	2.9	3.5	8.0	16.0
Philadelphia	3.0	6.2	7.8	11.2	41.7
New York	3.7	4.0	3.8	8.0	13.5
Cleveland	4.7	7.1	5.3	10.0	15.7
St. Louis	7.2	7.5	9.4	12.1	14.7
Pittsburgh	9.8	11.2	8.6	15.9	65.0
Detroit	10.0	17.8	15.0	18.1	21.1
Baltimore	12.2	15.5	18.0	23.7	35.1
GROUP 2: FROM 300,000 TO 500,000 POPULATION					
Seattle	2.3	5.1	3.0	5.7	25.2
Los Angeles	2.8	5.2	3.1	10.7	19.0
Newark, N. J.	3.5	3.5	5.3	6.8	14.6
Cincinnati	4.1	4.1	3.4	7.8	30.1
San Francisco	4.6	4.9	3.4	13.6	27.3
Milwaukee	6.2	5.9	14.9	13.6	27.0
Minneapolis	7.6	5.9	5.8	10.6	42.1
Buffalo	7.8	10.1	10.9	15.4	22.8
Washington	11.9	13.2	12.6	17.2	36.7
New Orleans	20.1	23.0	23.4	20.9	35.6
GROUP 3: FROM 200,000 TO 300,000 POPULATION					
Rochester, N. Y.	1.9	3.1	5.1	9.6	12.8
St. Paul	3.5	2.4	4.9	9.2	18.1
Jersey City	4.1	3.2	6.8	7.2	12.6
Providence, R. I.	4.5	5.4	5.1	10.2	14.1
Portland, Ore.	5.6	5.5	4.6	10.8	23.2
Indianapolis	6.6	10.0	26.6	20.5	30.4
Denver	8.7	5.1	7.2	12.0	37.5
Columbus, Ohio	8.9	7.6	13.4	15.8	40.0
Louisville, Ky.	12.4	12.2	9.7	19.7	52.7
Kansas City, Mo.	13.7	10.0	10.6	16.2	35.6
GROUP 4: FROM 125,000 TO 200,000 POPULATION					
Paterson, N. J.	2.1	11.3	1.4	9.1	19.3
Worcester, Mass.	4.6	4.8	3.7	5.0	11.8
Oakland, Calif.	4.7	1.9	4.0	8.7	21.5
Omaha	5.0	6.4	5.1	14.9	40.7
New Haven, Conn.	5.2	9.2	8.0	18.2	30.8
Scranton, Pa.	5.2	6.0	5.4	9.3	31.5
Fall River, Mass.	7.0	16.9	10.9	13.4	13.5
Spokane, Wash.	9.1	7.1	2.0	17.1	50.3
Syracuse, N. Y.	9.3	6.3	12.2	12.3	15.6
Toledo, Ohio	9.9	9.7	22.9	31.4	37.5
Atlanta, Ga.	14.4	16.8	17.9	31.4	58.4
Memphis, Tenn.	14.9	21.1	36.3	42.5	35.3
Birmingham, Ala.	31.9	54.1	42.6	...	...
Richmond, Va.	65.3	7.0	24.1	15.7	34.0

GROUP 5: FROM 100,000 TO 125,000 POPULATION

Lowell, Mass	1.8	6.9	11.4	10.2	13.9
Cambridge, Mass	2.7	4.4	0.9	4.0	9.8
Springfield, Mass	3.6	6.4	4.7	17.6	....
Camden, N. J	3.6	3.7	11.3	4.5	....
Bridgeport, Mass	3.9	6.4	9.0	5.0	10.3
Tacoma, Wash	5.7	2.5	3.5	10.4	....
Dayton, Ohio	6.9	13.7	14.7	14.8	22.5
Hartford, Conn	7.0	13.3	6.3	15.9	19.0
Salt Lake City	7.1	18.1	10.2	13.2	....
New Bedford, Mass	8.0	5.7	4.2	15.0	16.1
Trenton, N. J	9.4	12.3	6.3	22.3	....
Grand Rapids, Mich	10.3	12.2	15.6	25.5	29.7
Albany, N. Y	10.7	10.5	7.7	18.6	17.4
Reading, Pa	12.3	7.4	18.7	31.9	42.0
Dallas, Texas	12.6	19.4	27.5	....	....
Nashville, Tenn	32.7	18.3	27.3	40.2	61.2
San Antonio, Texas	54.3	25.7	16.9	29.5	....

TABLE II. DEATH RATES FROM TYPHOID IN 1918

First Rank (Under 5.0)

Chicago	1.4	Springfield, Mass	3.6
Lowell, Mass	1.8	Camden, N. J	3.6
Rochester, N. Y	1.9	New York	3.7
Paterson, N. J	2.1	Bridgeport, Conn	3.9
Seattle	2.3	Cincinnati	4.1
Boston	2.5	Jersey City	4.1
Cambridge, Mass	2.7	Providence, R. I	4.5
Los Angeles	2.8	San Francisco	4.6
Philadelphia	3.0	Worcester, Mass	4.6
Newark, N. J	3.5	Oakland, Calif	4.7
St. Paul	3.5	Cleveland	4.7

Second Rank (from 5.0 to 10.0)

Omaha	5.0	St. Louis	7.2
New Haven, Conn	5.2	Minneapolis	7.5
Scranton, Pa	5.2	Buffalo	7.8
Portland, Ore	5.6	New Bedford, Mass	8.0
Tacoma, Wash	5.7	Denver	8.7
Milwaukee	6.2	Columbus, Ohio	8.9
Indianapolis	6.6	Spokane, Wash	9.1
Dayton, Ohio	6.9	Syracuse, N. Y	9.3
Hartford, Conn	7.0	Trenton, N. J	9.4
Fall River, Mass	7.0	Pittsburgh	9.8
Salt Lake City	7.1	Toledo, Ohio	9.9

Third Rank (from 10.0 to 20.0)

Detroit	10.0	Louisville, Ky	12.4
Grand Rapids, Mich	10.3	Dallas, Texas	12.6
Albany, N. Y	10.7	Kansas City, Mo	13.7
Washington, D. C	11.9	Atlanta, Ga	14.4
Baltimore	12.2	Memphis, Tenn	14.9
Reading, Pa	12.3		

Fourth Rank (Over 20.0)

New Orleans	20.1	San Antonio, Texas	54.3
Birmingham, Ala	31.9	Richmond, Va	65.3
Nashville, Tenn	32.7		

TABLE III. AVERAGE DEATHS FROM TYPHOID PER HUNDRED THOUSAND IN EACH GROUP, 1916, 1917 AND 1918

Group	Year	No. of Cities	Total Population	No. of Deaths	Av. Deaths per 100,000
1	1916	9	13,743,746	854	6.2
1	1917	9	14,027,263	774	5.5
1	1918	9	13,809,901	598	4.3
2	1916	10	4,053,281	344	8.5
2	1917	10	4,150,099	329	7.9
2	1918	10	4,372,088	298	6.8
3	1916	10	2,635,983	248	9.4
3	1917	10	2,701,029	173	6.4
3	1918	10	2,773,716	193	6.9
4	1916	14	2,250,991	330	14.7
4	1917	14	2,310,372	307	13.3
4	1918	14	2,449,736	331	13.5
5	1916	17	1,983,918	235	11.8
5	1917	17	2,031,313	229	11.3
5	1918	17	2,053,215	240	11.7
Total	1916	60	24,667,919	2,011	8.1
Total	1917	60	25,220,076	1,812	7.2
Total	1918	60	25,458,656	1,660	6.5

TABLE IV. TOTAL AVERAGE TYPHOID DEATH RATE (1910-1918)

	Total Population (57 Cities*)	Typhoid Deaths	Typhoid Death Rate per 100,000
1910	20,996,035	4,114	19.59
1911	21,545,014	3,391	15.74
1912	22,093,993	2,775	12.56
1913	22,642,972	2,892	12.77
1914	23,191,951	2,406	10.38
1915	23,740,930	2,068	8.71
1916	24,205,359	1,842	7.61
1917	24,740,068	1,647	6.65
1918	24,971,278	1,557	6.32

* Three cities are omitted from this summary because data for the full period are not available.

Concrete Floor Stands Big Overload Without Collapse

Sheet Tin Piles Give Maximum Loading Six Times Design Load, and Though Beam-and-Girder Floor Cracks and Deflects It Does Not Fail

LOADS from four to six times those for which the floor was designed have just been put on a reinforced-concrete building in Long Island City, N. Y., through the almost criminal negligence of a warehouseing superintendent. The floor has cracked badly—so badly that the Superintendent of Buildings of Queens Borough has ordered the load mostly removed and the floors shored up, and has required that they be repaired. There was no definite collapse, however, nor is there any evidence of any adverse effect on the rest of the building, a remarkable testimonial to the effectiveness of this type of construction.

The building in question is known as the Kindel Bed Co. building. It is located in Long Island City in one of the boroughs of New York City. It is a four-story structure, and the section in question is 80 ft. wide and 218 ft. long. Transversely it is divided into three bays, the outer bays being 26 ft. 4 in. in span and the middle

CONCRETE FLOOR LOADED WITH BOXES OF SHEET TIN EACH WEIGHING 122 POUNDS

bay 27 ft. 4 in. In the other direction, columns are spaced 18 ft. c. to c. The floor is a girder, beam-and-slab type, 14 x 26-in. girders running lengthwise of the building and 8 x 22-in. beams being spaced 6 ft. c. to c. and spanning between the columns or the girders. The building was erected in 1916 and was designed for manufacturing purposes to have a load on this floor of 200 lb. per square foot.

The original owners of the building had vacated it, and the second floor, through a series of leases, came into the control of a warehouseman in New York City. Some time early this year he began storing, on the floor, boxes of sheet tin being held for the Standard Oil Co. preliminary to shipment to the Far East. These boxes are of various sizes, but the main ones are 14 x 8¾ in. in plan and about 4 in. deep, and carry sheet tin

to such an amount that the gross load of the tin plus the box is 122 lb. This gives a loading of about 68 lb. per square foot. Apparently the entire floor, except a 4-ft. aisle down the inside of the column rows, was loaded with these boxes, some of which were piled as high as 20 deep. It is the opinion of observers that in some places the loads reached 1300 lb. per square foot and that the uniform load must have been equivalent to a load of 900 lb. per square foot over the entire floor, about 4½ times the design load.

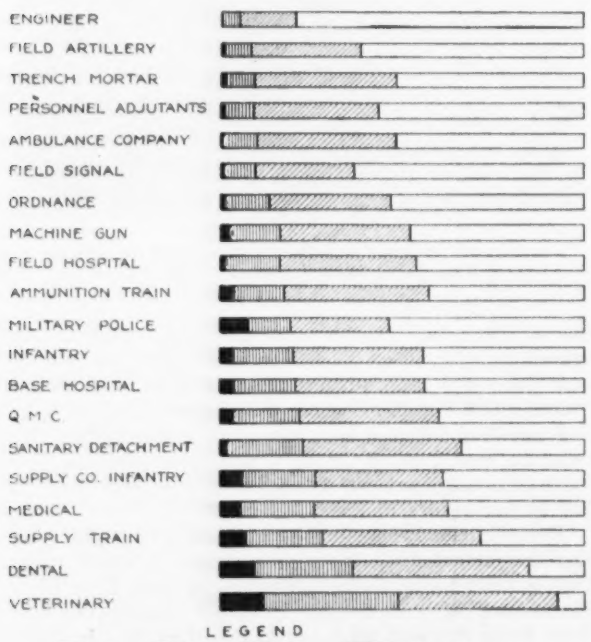
The first warning of trouble is reported to have been given by the night watchman, who heard omirous rumblings and crunchings which so disturbed him as to make him get outside of the building and stay out all night. The next day he reported the trouble, and it was found that many cracks were appearing in the floors. There was also a certain deflection, although this was not very considerable nor has it been measured. At any rate, Superintendent of Buildings Moore, immediately upon being informed of the trouble, put an "unsafe" order on the building and had a court require the survey demanded by New York law for such contingencies. Under the authority of this court order he removed enough of the load so that at present the floor is carrying somewhat over its designed amount. At the same time he strutted up those sections of the floor where the cracking appeared to be most dangerous. At present it is the intention to repair the floor or to replace it, although the exact method to be carried out has not been determined.

The cracks in the floor seem to indicate that a continuous beam action was carried clear across the three panels of the 80-ft. width. Cracks appear in the floor-slab of the interior panel about the point of inflection, and in some places are carried down a short distance into transverse beams.

Similar cracks around some of the columns appear in the longitudinal stringers, and in all cases the cracking seems to have been roughly circular around the heads of the columns.

Engineer Officers Rank First in Army Mental Tests

TYPICAL of the results obtained under the direction of the Division of Psychology, Medical Department of the United States War Department, is the chart reproduced herewith, which indicates that of all the classes of officers examined the engineer officers show the highest grade. The tests upon which the officers' ratings depend were prepared by a committee of the American Psychological Association and of the National Research Council, for the purpose of determining relative intelligence. While admitting that a man's value to the service should not be judged by his intelligence alone, it has nevertheless been thoroughly demonstrated that the intelligence ratings are useful in indicating a man's probable value to the Army service.



RELATIVE GRADES OF OFFICERS—ENGINEERS RANK FIRST

Letter ratings have been used as follows: A, very superior intelligence—this grade is ordinarily earned by only 4 or 5% of a draft quota, and is composed of men of marked intellectuality; B, superior intelligence—this class includes less exceptional intelligence than that in class A, and is obtained by 8 to 10 soldiers out of 100; C +, high average intelligence—this group includes 15 to 18 per cent. of all soldiers and contains a large amount of noncommissioned-officer material; C, average intelligence—includes about 25% of all soldiers; C —, low average intelligence—includes about 20 per cent. who, though below the average in intelligence, are usually good privates and satisfactory in work of routine nature; D, inferior intelligence—includes about 15%; and D — and E, very inferior intelligence. The comparison in the diagram is for officers only.

Engineers in United States Public Health Reserve

By recent Congressional legislation providing for a United States Public Health Reserve, provision is made for commissioning a corps of sanitary engineers, epidemiologists, chemists and other nonmedical men for a period of five years, with pay and allowances equal to those in the present regularly commissioned medical corps. Those wishing to be enrolled must be qualified citizens of the United States and must apply to the Surgeon General, United States Public Health Service, for permission to appear for examination. The grades and corresponding pay and allowances at Washington for sanitary engineers, under the legislation named, will be as follows: Assistant sanitary engineer, $2623 a year; associate sanitary engineer, $3200; sanitary engineer, $3976; senior sanitary engineer, $4651; directing sanitary engineer, $6325. Commissioned reserve officers will normally be on inactive duty without pay. They may be called to active duty for a period not exceeding one month annually for special training, and they will be subject to call in any public-health emergency. Under the new legislation men in the nonmedical branches of public-health will receive equal recognition with men in the medical branches of the service.

Labor Efficiency Good on Percentage Contracts

Carefully Kept Figures on Peace-Time Construction Contradict Common Charge Against This Form of Contract—Inefficient Laborers Rather Than Type of Contract Cause of Trouble on War Construction

By Henry C. Turner
President, Turner Construction Company, New York

The editor asked the Turner Construction Co. the following questions:

1. Is it your experience that labor is less efficient in cost-plus construction?

2. If less efficient, is the fact due to the form of contract, or to some other cause?

Mr. Turner's illuminating reply is based on careful unit-cost records in all the contracts of the company during peace operations just prior to the war, and on a large amount of war-time construction. Not only does the company see no labor inefficiency in the cost-plus system but, as stated in detail, it thinks that this form of contract has many advantages.

DURING the year 1918 we were engaged almost entirely in Government work, carried on under the standard percentage with a limiting fee form of contract. To obtain a comparison between our experience with percentage and lump-sum work, it is, therefore, necessary to go back to the year 1917. In that year we find that we built 22 factories and warehouses of reinforced concrete, on which our contract exceeded $100,000 each, averaging $413,000 each. Of these 22 buildings 13 averaging $470,000 each in cost were built under a percentage form of contract and nine averaging $329,000 each in cost were built under a lump-sum form of contract.

While some of these buildings were more elaborate than others, they were all of the factory and warehouse type and enough alike to make an average comparison of units between the percentage group and the lump-sum group possible. Some of the buildings considered were flat-slab and others beam-and-girder, and later in this analysis will be noted the influence of this fact on the units obtained. Attention will also be drawn to the effect which the height of a building has on the unit cost of floor forms, etc.

For purposes of comparison of cost, three labor units have been selected covering the three principal divisions of the work included in such construction.

Item 3-F. Cost of carpenter and labor work per square foot of floor required for placing and removing floor forms, including all hoisting and miscellaneous work in connection therewith. This item does not include the cost of making the forms before they are used for the first time and, therefore, a comparison is possible as between buildings having a different number of stories.

Item 22. Cost of labor per cubic yard for all labor in connection with the mixing and placing of concrete. An average of this unit will give a very fair comparison.

Item 30. Cost of all labor per ton for receiving, handling, bending and placing steel reinforcement. As the labor conditions under which this work is done are different in the metropolitan districts from the conditions existing outside of these districts, one comparison is made between jobs located in the metropolitan districts and another comparison is made between the jobs outside of such districts.

There is also included in the table the amount of money spent for all labor disbursed under Item 19, "General Expense," expressed as a percentage of the total payroll for the job. This is done to show that the units obtained on the 3-F, 22 and 30 Items were not influenced by incorrect charging of labor to General Item 19, thereby reducing the amounts properly chargeable to the cost of forms and placing concrete and steel.

The results of the comparison are given in the accompanying tabulation:

COMPARISON BASED ON A STUDY OF COST UNITS ON ALL FACTORIES AND WAREHOUSES COSTING OVER $100,000 BUILT BY TURNER CONSTRUCTION CO. IN 1917

TOTAL NUMBER, 22

	Average unit on 13 percentage jobs	Average unit on 9 lump sum jobs	Percentage jobs were cheaper by	Lump sum jobs were cheaper by
Item 3-F. Cost per square foot of placing and removing floor forms	5.75c.	6.25c.	8%	
Item 22. Cost per cubic yard of mixing and placing concrete	$1.02	$1.04	2%	
Item 30. Cost per ton of receiving, bending, fabricating and placing steel reinforcement on jobs in the metropolitan districts	(10 jobs) $15.71	(4 jobs) $14.89		5%
Item 30. Cost per ton of receiving, bending, fabricating and placing steel reinforcement on jobs outside of the metropolitan districts	(3 jobs) $9.01	(5 jobs) $8.87		2%
Item 19. General expense. The amount charged to this miscellaneous item is expressed as a percentage of the total payroll	1.8%	2.3%		

Effect of Various Items

The items will be taken up separately; comparisons are made under Item 30 for jobs located within the metropolitan districts and for jobs located outside of such districts.

Placing and Removing Floor Forms—There is some difference in the cost per square foot for the 3-F item as between flat-slab and beam-and-girder construction. By a coincidence it happens that 14% of the floor area in the percentage jobs was beam-and-girder and 86% was flat-slab, while in the lump-sum jobs 13% was beam-and-girder and 87% was flat-slab. Because of this similarity the comparison made between the average units on the percentage work and on the lump-sum work is not influenced by any difference due to the slightly greater cost of beam-and-girder forms over flat-slab forms. The column spacing was near enough the same in all of the buildings, so that any difference due to this element may be disregarded. The 3-F item has a tendency to be lower in buildings having a greater number of stories, because the 3-F unit for the first floor is nearly always higher than the 3-F unit for floors above the first. As all of the buildings studied are five stories, or over, in height, with the exception of two, which are four stories, the influence of the element of height is very slight. It is to be noted that the next to the lowest 3-F unit obtained on any of the 22 buildings was at the Beckers Aniline & Chemical Building.

which is only five stories high, and the units made on the two four-story jobs are each below the average. It is believed that a comparison of the 3-F unit as between the percentage group of jobs and the lump-sum group is a fair comparison and means that if anything our organizations on the percentage had the jump on the lump-sum job organizations for this item.

Mixing and Placing Concrete—With equal efficiency on the two classes of construction the averages of Item 22 should run very close together, and such is the case, the difference being only 2% in favor of the percentage organizations.

Receiving, Bending, Fabricating and Placing Steel Reinforcement in Metropolitan Districts—The lump-sum jobs beat the percentage jobs by 5%, and this difference is probably justified by the more difficult conditions affecting this Item 30 that existed on the percentage group of buildings.

Receiving, Bending, Fabricating and Placing Steel Reinforcement on Jobs Outside of Metropolitan Districts—The lump-sum jobs beat the percentage jobs by 2%. The comparison is a fair one and should be a true indication of efficiency.

General Expense—The amount of money covered by the classification in Item 19 is very small compared with the other items used in the table. The only reason for tabulating the item was to show by its smallness that improper charges had not been made to this general item, thereby reducing the charges of payroll made to Items 3-F, 22 and 30.

Low Costs Not Confined to One Type

If lowest units made on these 22 jobs are sought it is found that the lowest unit in placing and removing floor forms was made on the Belleville job, a percentage contract, and that the next lowest unit was made on the Beckers Aniline & Chemical Co. job, also a percentage contract. The lowest unit made in placing concrete was on the Bush Service Building, a percentage contract, and the next lowest was at the United Cigar Stores Building, which was also a percentage contract for the Bush company. The third lowest was at the Belleville job, which was a percentage contract, and the next was at the Winchester Woolen Mills, a lump-sum contract. The lowest unit on placing steel reinforcement, outside of the metropolitan districts, was on Endicott-Johnson, a lump-sum job, and the next lowest was for Belleville, a percentage job. In the metropolitan districts the lowest unit for placing steel reinforcement was at the Beckers Aniline & Chemical Co. percentage job, the next best was the Bush Service Building, also a percentage job.

It is believed that the figures justify the statement in reply to the first question that in a properly organized construction company there is no difference in efficiency in labor engaged on percentage work as compared with lump-sum work. So far as this company has ever been able to see, a good superintendent, or a good foreman, shows the same interest in his job whether it is on percentage or lump sum. This will always be the case if he works for a company which rewards him just as quickly for good work on a percentage job as for good work on a lump-sum job and penalizes him just as severely on one class of work as on the other.

Answering the second question—there seems to be no valid reason why labor should be less efficient on the percentage job than on the lump-sum job. A workingman is naturally primarily interested in his own welfare, and hence in the keeping of his job. If negligence and a lack of interest in his work lead to his discharge on the percentage job just as quickly as on the lump-sum work, while he finds that diligence on the percentage job is rewarded by advancement and continuous employment by the contractor, he will work just as hard on one form of contract as on the other.

There have been published recently a number of articles in which the position was maintained that percentage work has ruined the moral character of the American contractor and the American workingman. This company believes the opinions expressed in these articles are based either upon some unfortunate personal experience with the percentage form of contract, or are founded on observation made on the general run of percentage work during the war.

Many owners have had trouble over percentage contracts, just as many owners have had trouble over lump-sum contracts, but in nine cases out of ten the fault has been with the owner in not making sufficient investigation before he awarded his contract. There are plenty of good contractors to handle percentage work if the owner will only take the trouble to find them. Any owner intending to buy a piece of property will have a very careful search made of the title, and will have someone spend much time in investigation and study before he decides to purchase. Too often the owner will select a contractor because the contractor's selling agent sometimes knowingly, but much more often through lack of knowledge of construction work, will promise anything the owner wishes in the way of speed or price. Surely, the selection of a building contractor for the confidential position he occupies on percentage work is worthy of some study, but it is not infrequent for an owner to award a large percentage contract with less study and investigation than he would give to the purchase of a motor car.

Owner Should Study Both Systems

It is not difficult for the owner to get reasonable assurance that he is picking the right man for the job. In the first place, no contractor should be selected for percentage work unless he is very well known to the owner or has a very considerable record on such work. Let the owner ask the contractor for a list of all jobs he has built. Very likely several of these jobs were for persons known to the owner, in which case the investigation will be easy. If the entire list was for strangers, then let the owner pick about a dozen jobs similar to the project he has in mind and thoroughly investigate the contractor's record on all of the jobs so selected, having his representative make personal calls, where possible, to obtain the information. The price to any owner for satisfactory work on a percentage basis is the comparatively slight trouble of thorough investigation before the contract is let.

It is a fact that a considerable prejudice against the percentage or fixed-fee form of contract has arisen because of observations made on such work during the war. Conditions in the building industry were in many cases deplorable during the war, but these conditions would have existed in most of these cases had the work been on a lump-sum basis. The majority of the large Government operations were built far away from any labor market, which made it necessary to hire men in

the large cities and send them to these out-of-the-way places where they were housed in wooden barracks. In most cases the rates of wages established by the Government, and made obligatory on percentage contracts in such out-of-the-way places, were lower than the wages paid in the large labor markets in which men were recruited. As more work was always available in the large cities than the supply of competent mechanics and good laborers living in such cities could handle, there was no incentive for a good man to leave his home. The result was that these out-of-the-way jobs had to be built with so-called floating labor; there was no other way to get the jobs done. This labor in many cases was not physically fit to do a day's work and, in order to get the work done at all, it was necessary for the superintendents and foremen to exercise the greatest of forbearance.

War-Cost Additions Due to Inexperience of Workmen

The experience of this company during the 1918 war period illustrates the condition that existed. It was then building for the Government, at the same time, the Naval base in Brooklyn, the Army base in Brooklyn and the Navy and War office buildings in Washington. During the war, on account of the shortage of labor, the Government ordered a 10-hour day for laborers mixing and placing concrete, paying time and one-half for overtime. The labor rate in Brooklyn was $3.25 to $3.60 for eight hours, while in Washington it was $3.20 for eight hours. The cost of mixing and placing concrete per cubic yard on the naval base was $1.25, including a large amount of miscellaneous work, $1.19 per cubic yard on the Army base and $1.98 per cubic yard at the Navy and War buildings in Washington. The rate of wages per hour was lower in Washington than in Brooklyn, and the overtime affected jobs in both cities to an equal extent. The more difficult nature of the work in Washington would justify a difference of only about 20c. per cubic yard had the wage rates in the two cities been equal, hence an inspection of the unit costs on the three jobs shows the inefficiency of the workmen on the job in Washington as compared with the workmen in Brooklyn.

In Washington there was no home labor market and no quarters for housing men except temporary wood barracks. As a result, in order to keep the job supplied with the 1,400 laborers required, it was necessary to ship into Washington 4,000 of such men as could be gotten from New York, and in addition considerable numbers were obtained in other cities as far west as Chicago. It is to be remembered that it was very much easier to persuade fair workmen to go to Washington than to get such men to go to the small out-of-the-way places in which most of the Government plants were located. Inefficiency and resulting high units were, therefore, to be expected in such places, and they would have existed on the work of any honest contractor in the same degree had his work been done on a lump-sum basis.

Comparing the results obtained on the naval base and on the Army base in Brooklyn with the results the company was able to get in 1917, it is found that the cost of labor per hour of actual time worked was 18% higher in Brooklyn in 1918 than in 1917, due to an increase in the average rate from $3.12 per eight hours in 1917 to $3.35 per eight hours in 1918, and the effect of paying time and one-half for the two hours of overtime each day in 1918. Hence the units of $1.25 per cubic yard made on the naval base in 1918 and $1.19 made on the Army base in the same year are equivalent to units of $1.06 and of $1.01, respectively, if made on the same jobs in 1917. This comparison shows that there was no serious loss of efficiency during the war in the labor of placing concrete in the Brooklyn district, due to the fact that Brooklyn is a good labor market, and, therefore, the gangs were composed largely of experienced concrete laborers, many of whom had worked for the company for years.

To state the effect of the war condition on construction work in another way—the experienced workman in most lines of the construction industry continued to give good service during the war when working for his old employer, but there were not nearly enough of these experienced workmen to carry on the Government building program and it therefore became necessary to employ large numbers of men new to the industry. These men were frequently found inefficient. The effect of this dilution was felt to some extent in the large labor markets and to a considerable extent in places like Washington, but affected work in out-of-the-way places very seriously, because, the established Government rates of wages on percentage jobs being lower there than in the large labor centers, it was almost impossible to get good men to leave their homes to go to such places.

There is no reason or justice in forming an opinion as to the relative advantages of percentage or lump-sum work based on war-time experience. Where such a comparison is made, the person making it is generally comparing in his mind the efficiency of the percentage job he saw during the war with the efficiency of lump-sum jobs he may have seen carried on before the war, or if he does have in his mind one of the comparatively few lump-sum jobs built during the war, he forgets that the contractor on such a job was not subject to the Government wage scale and, therefore, by paying wages above that scale could get the pick of the men.

Two Types About Same During War

Comparing again the costs obtained on percentage and on lump-sum work, it is interesting to note that the average unit of $1.47 for labor per cubic yard of concrete on the naval base, Army base and Navy and War office buildings was only 1c. higher per cubic yard than the $1.46 unit made on the only large lump-sum job we built during 1918. On the three Government jobs, the average cost of Item 3-F was 8.03c. as compared with 9.19c. on the lump-sum job. The cost of placing steel reinforcement on the Government jobs in Brooklyn in 1918 averaged $21.32 per ton, which is a considerable increase over the 1917 average for percentage and lump-sum jobs of $15.26 obtained from the table. Approximately $3.97 of this difference is due to a 26% increase in the average hourly rate of wages paid, caused by a 9% increase in the rate per eight hours and the effect of overtime. The balance of the difference between the 1917 and the 1918 unit, amounting to $2.09 per ton, must be charged in part to the fact that on the Government work economy had to be sacrificed to speed to a certain extent, and in part to a falling off in the efficiency of the workmen.

The cost of placing steel reinforcement on the job in Washington during the war was $16.22 per ton. This is

an abnormally high figure for such work outside of the metropolitan districts and was due to the inefficient men obtained in Washington. Almost the entire experienced steel gang left and went to work for another contractor who had a lump-sum contract, because he paid wages above the scale fixed as a maximum by the Government for percentage work in Washington. This statement is not to be taken as a criticism of the other contractor. He had taken his contract before the full effect of war conditions was realized and had to get fairly efficient men or suffer a very severe loss.

The percentage and cost-plus-a-fixed-fee form of contract is of great advantage to the responsible contractor in helping him to secure work on an equitable basis, and is of equally great advantage in many cases to the owner, enabling him to get work started on important projects months before detailed complete plans and specifications could be prepared for lump-sum bidding.

It is felt that the importance of the subject has justified a frank statement of the facts as this company has found them, because in our opinion any general condemnation of the percentage contract is warranted.

Panels of Movable Weir Collapse Automatically

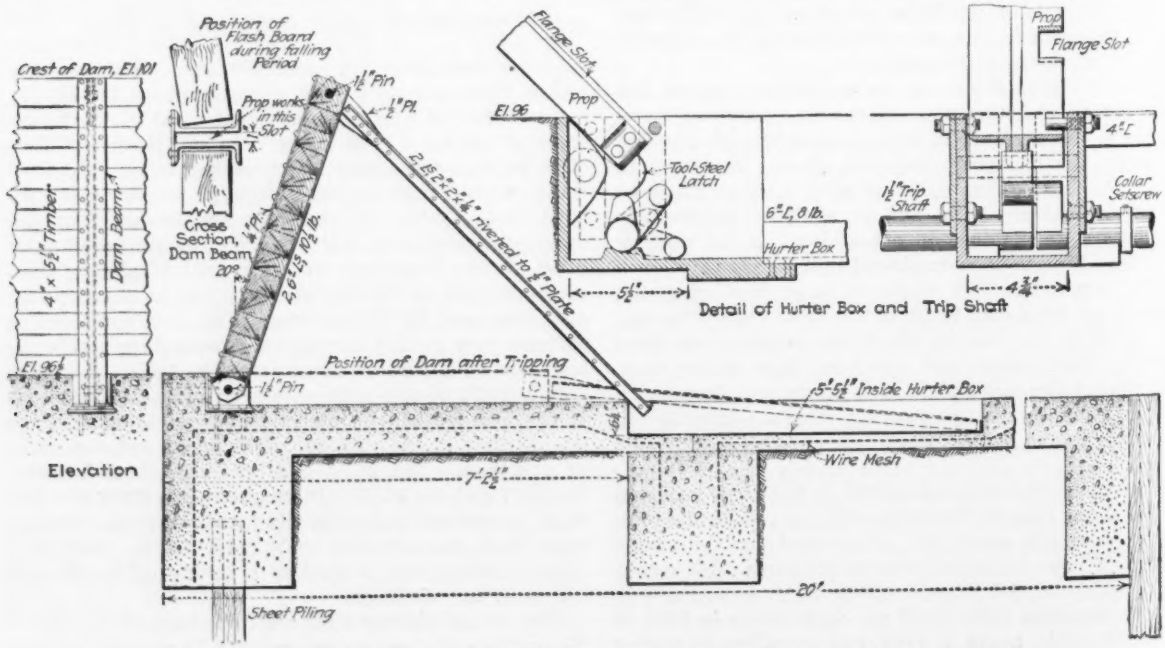
Tripping Started by Float in Chamber Filled as Flood Rises — Double Skimming Eliminates Sediment from Canals

FALLING flashboards trip those adjacent in succession in a collapsible dam built across the Huerfano River, Colorado, to divert water for irrigating 2500 acres of land belonging to the Butte-Mesa Reservoir Land Co. The tripping mechanism operates automatically should a great flood from a cloud burst unexpectedly raise the water 4½ ft. above the top of the panels. This probably will occur not oftener than once in ten years, when no attendant would be on hand to do the tripping.

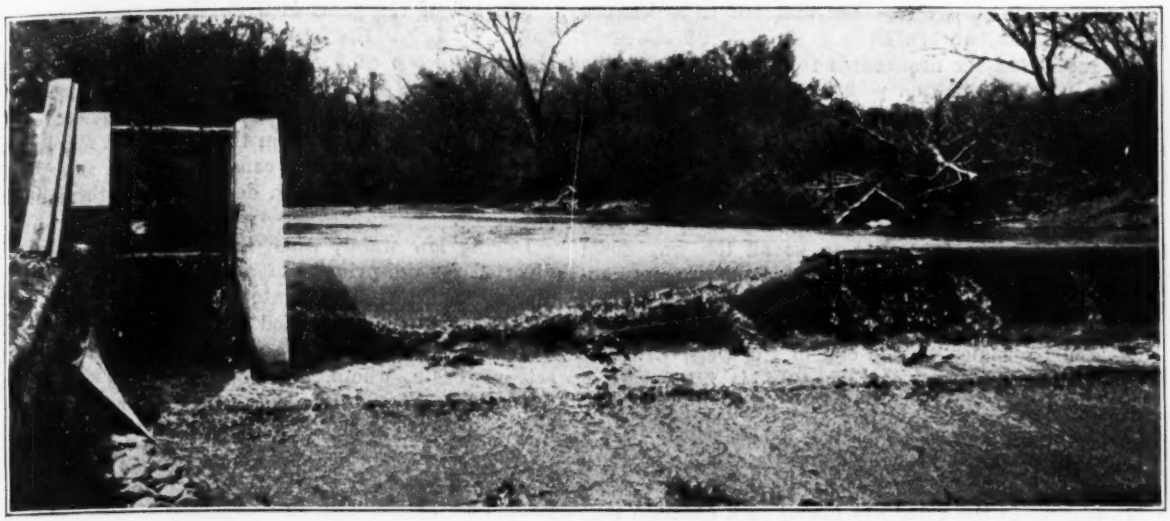
The Huerfano River rises in the Sangre de Cristo Mountains, the crest elevations of which are 9000 to 14,000 ft. above sea level. The drainage area is 620 square miles, of which 170 square miles are above the 9000-ft. contour. The fall of the river is 50 ft. per mile at the dam site, increasing until 150 ft. per mile is reached at the foothills. Along the river the irrigation ditches usually have brush and stone diversion weirs. These storms occur mostly during the growing season, causing loss of crops, for reconstruction cannot be done until the low-water period.

The necessity for the adoption of a movable structure, as against a fixed weir, arose from the fact that the river is subject to sudden floods by cloud-bursts, which often convert it into a raging torrent. This condition calls for a structure that would allow the water to rise above the top, having no obstruction over the weir crest, and which may be immediately released automatically or by employees, so that the structure would fall to a horizontal (recumbent) position on the floor. This would leave no obstruction to the freedom of discharge of water, logs and débris swept down from above, and would free the entire cross-section area of the channel. It would also avoid the flooding of adjoining farm lands so far as protection may be given by the increased waterway through the weir.

With its steep slope and the flashy nature of the violent floods the river has great erosive and transporting power. Large quantities of débris are carried along the bed and in suspension. A fixed weir across such a stream would have given ground for claims for overflow damages, on the ground that the regimen of the stream had been entirely changed and that the running water would establish another channel condition. Finally, shoaling would extend upstream some distance from a beginning depth equal to the height of the weir to a point where the first grade is broken.



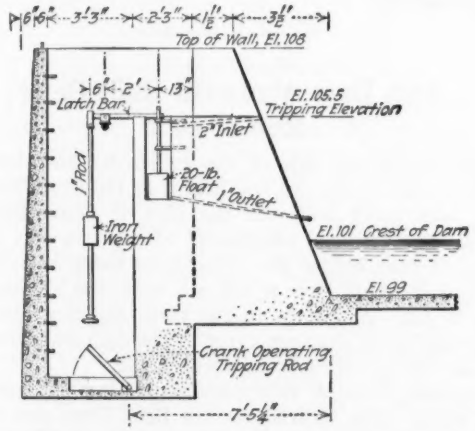
AUTOMATIC FLASHBOARDS DROP WHEN WATER IS 4½ FEET ABOVE CREST OF DAM



PANELS LIE PRONE BEFORE STATIC HEAD IN POOL CAN CHANGE TO VELOCITY HEAD—FIFTH PANEL PROPPED UP INTENTIONALLY

This contention might be hard to disprove before a local jury. With a movable weir, all danger from deposits of sand is removed, as they can be washed down the river when such result is required.

Location of the headworks was maintained at the site of the old diversion weir, and the elevations were



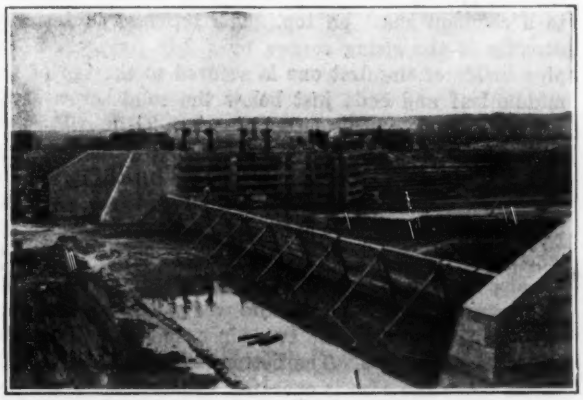
DETAIL OF AUTOMATIC TRIPPING CONTROL

controlled by the grade of the 2½-mile inlet canal, of 100-sec.ft. capacity, to the existing Homestead reservoir.

The diversion works consist of a reinforced-concrete apron, with steel frames for a movable weir, and having the headgates at right angles to the weir. The latter is 104 ft. long, divided into 13 panels, 8 ft. long and 5 ft. high, placed at an angle of 20 deg. from the vertical. The bed of the stream is composed of sand and gravel from 10 to 15 ft. thick, overlying a bed of hardpan. A row triple-lap sheet piling was driven in a trench excavated through the sand and one foot into the hardpan, extending entirely around the apron and abutments. The apron, 20 ft. wide, was placed flush with the river bottom. At the upper edge is a sill 6 in. high, behind which the bottom end of the frames forming the collapsible portion of the weir is hinged. The sill also protects the flashboards from injury when in the prone position. The posts are two channels, into which the horizontal flashboards are placed. These are supported by a hinged prop of angle irons, the foot resting upon a latch, which in turn is retained in place by a cam on the end of a tripping rod.

When the water rises 4½ ft. above the top of the weir an automatic mechanism will be put in operation by the admission of water to a float-well in the weir abutment. Raising the float releases a system of levers and allows a heavy weight to drop upon an extended arm of the first tripping bar. This turns the cam from under the latch of the prop, when the pressure of the water and the silt forces the panel to fall. In moving 1½ in. this panel strikes a crank on the next tripping bar. This action continues rapidly until all the panels are thrown down in succession.

Tripping may be done by an employee at any time, even under a small flow of water. Raising or replacing the panels forming the weir is not required until the stream has fallen to a normal stage, but it can be done in 1 to 1½ ft. of water if necessary. The steel frames are set up, then the boards are placed between them all the way across the stream at the same height above the apron before the head has much increased, and



TRASH RACK GRILLAGE BARS ENTRANCE TO HEADGATES

are pressed so closely together that but little leakage will take place between them. The fall of the weir is so rapid that the flashboards remain in place in the frames. The picture on p. 819 was taken of the operation for the first time of four of the gates, the fifth gate being braced up to save the trouble of resetting all the gates. The engineer snapped the shutter of his camera at the instant he saw the first gate begin to move, but the time lost in getting the actual exposure, $^1/_{100}$ sec., gave time for the first gate to go all the way down while the fourth gate had just started the warping motion taken by the flashboards. The water had not yet followed the gates.

A scouring sluice, at the end of the weir, with the floor at the same level as the apron, is fitted with a steel radial gate, 6 ft. wide and 5 ft. high. The purpose is to scour out any silt that may be deposited in the forebay between the headgates and the trash rack, and to regulate the water level as required.

Headgates to the canal are placed in a concrete wall at the end of the weir. They are of the overflow or skimming type, 9 ft. long and 6 ft. high, and are formed

LONG, NARROW SETTLING BASIN EASILY WASHED CLEAN —SANDY SLOPES SILTED SHOW BLACK

of three leaves each 2 ft. high, so arranged that one, two or three of the horizontal leaves may be raised, depending on the river stage. The leaves are of structural steel shapes and plates, operated by bevel-gear lifting devices, having two rising stem gate stands, connected to a common shaft on top. The top leaf is fastened directly to the rising screws by a 3-in pipe. A 2½-in. pipe inside of the first one is secured to the top of the middle leaf and ends just below the solid screw stem. Working inside of this latter pipe is a 2¼-in. cold-rolled steel rod fastened to the lowest leaf and extending just below the top of the middle pipe. By inserting wedges through the two outer pipes and the rod, all the leaves can be raised simultaneously to take water when the river is at its lowest stages. When it is raised so that the level is, say, 2 ft. higher, the gate is lowered to the floor and the wedge transferred to a slot passing through the two pipes, but just above the top of the solid rod. The bottom leaf then will not be raised when the gate is operated. Should the river rise another 2 ft. the gate is again lowered and the wedge removed, when the upper gate only may be lifted.

The sill of the gates is 3 ft. above the weir apron and 2 ft. below the top of the weir, which gives a sluiceway depth of 3 ft. in front of the gates, and a depth of water of 2 ft. through the gates before there is a flow over the weir. By this arrangement only surface water is taken from the river, and silt is prevented from entering the canal. The full supply can be obtained with only 2 ft. depth passing through the gates.

During low water, when the entire stream flow is diverted for the priority of an old ditch right, all the moving sand and silt go into the settling basin. Also, when the stream is in flood and turbid and turbulent a certain amount of silt unavoidably goes into the settling basin, where, meeting practically still water, the sediment is mostly deposited. The settling basin has a capacity of 55,000 cu.ft. and is that portion of the canal between the headgates and a steel radial sand or sluicing gate. It is 660 ft. long, and has a concrete bottom 6 ft. wide, with 1½ ft. vertical height, excavated slopes 1 on 1 and a grade of 1½ per cent.

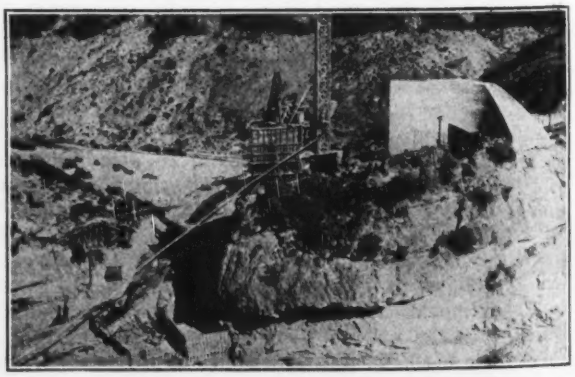
A 12-ft. weir to the inlet canal at the sand gate structure again skims the water from the top. There has been no deposit of river silt in the canal, which has a grade of 0.7 ft. per 1000 ft., since it was put in operation.

T. W. Jaycox, consulting engineer on the design and construction of these works, states that they have been in operation two years and have satisfactorily met the requirements.

Arch Dam Abutment Built Before Rest of Dam

BECAUSE one side of the cañon did not rise high enough to take the full height of the Gibraltar arch dam now being built for the City of Santa Barbara, Calif., an "artificial abutment" of concrete was placed one full year before the actual dam work was started, so that it would have a full set when the pressure began to act. As shown in the view, the abutment is a continuation of the arch curve of the dam and forms the inside face of the spillway just beyond.

Quinton, Code & Hill were consulting engineers on the work. The contractors are Bent Bros. and W. A. Kraner, the latter being in personal charge of construction.



"ARTIFICIAL ABUTMENT" TO ARCH DAM ALSO SERVES AS BUTTRESS BETWEEN MAIN DAM AND SPILLWAY

23rd Engineers Being Held to Repair French Roads

General Pershing Carrying Out Policy Insisted on by French Government—General Black Urges Patriotic Acceptance of Situation

By Wingrove Bathon
Washington Representative of "Engineering News-Record"

An INVESTIGATION in Washington of the reasons why the 23rd Engineers are still being held in France, notwithstanding the fact that the armistice was signed more than five months ago and that these engineers are needed in the United States now for the building of roads at home, discloses the official information that the French Government has represented to Washington that the damaged highways in France in the sectors used by American troops should be rebuilt and repaired by the American engineers before they go home; that the United States Government has accepted that point of view; and that General Pershing is now carrying out that policy.

Coincidentally, however, Washington is expecting to hear soon by cable from Secretary of War Baker, now in France, as to what the 23rd may expect, following the passage of a resolution by the American Road Builders' Association creating a committee which took up the matter of the possible return of the 23rd with the Secretary of War through the Bureau of Public Roads and the Secretary of Agriculture, the Secretary of War having promised that he would personally present to General Pershing the matter of the return of the engineering regiments.

Basis of Men's Dissatisfaction

At the same time, the investigation above referred to brings forth the official request from Major General Black, chief of engineers of the Army, in Washington, that there shall be a cessation of complaint on the part of the men in the 23rd, who, he points out, "signed up for the war," bearing in mind, he says, that the President has not yet proclaimed peace, and that therefore the war has not yet actually ended. The complaints of the men, it may be here stated, are based principally upon the fact that they are doing pick-and-shovel work in many cases, when they were promised that they would not be obliged to do so, and that there would be labor battalions to do such work; also, that if they are not returned to the United States now, to go back into their old positions while the road-building season is on in the United States, they might just as well be kept in France until next winter.

The request for a patriotic acceptance of the situation mentioned in the preceding paragraph is made by General Black not only of the men in the 23rd, but it is made of the employers, and would-be employers, of the men in the regiment, many of whom have been urging the return of the regiment. The request is also made by General Black of the committee, referred to above, appointed by the American Road Builders' Association.

Finally, the request for a patriotic suspension of judgment and activity concerning the 23rd is made by General Black of *Engineering News-Record*, which was instrumental in recruiting the 23rd Engineers, and which, since the armistice was signed, has advocated the return of the 23rd.

The investigation at Washington to which reference has been made was undertaken as the result of many activities throughout the United States which have to do with the desire to get the highway builders and other engineering regiments home from France. These activities are growing, and others are on the point of springing up all over the country. They will undoubtedly find expression and championship on the floor of the Senate and the floor of the House of Representatives as soon as the expected extra session of Congress assembles. But the investigation was undertaken more especially because of the great number of letters received by *Engineering News-Record* direct from men of the 23rd in France, complaining of their condition, and asking the assistance of this journal in bringing them home, in the same sort of manner that the men of the 23rd accepted advice from *Engineering News-Record* in getting into the 23rd, and going to France to serve their country. These letters were offered to General Black, minus their signatures, so that there would be no question of the War Department being obliged to take official cognizance of unofficial complaints, although General Black pointed out that it was not necessary for him to see them, as the War Department has received many other letters on the same subject. At the same time, the following statement was made to General Black, in writing, over the signature of the editor of *Engineering News-Record*:

> In the fall of 1917, under request from the officers detailed to raise a regiment of highway engineers, *Engineering News-Record* did its utmost through advertising to bring into the 23rd Engineers men of exceptional talent and ability as road builders.
>
> This regiment is still abroad, and for the following reasons we beg leave to urge upon the War Department the advisability, in the interests of road building in this country, of the early return of these men:
>
> 1. As is commonly known, we are embarking on a highway-building program of exceptional magnitude, due to an endeavor not merely to catch up with work delayed by the war, but also to provide employment for returned soldiers. Highway building is an art that is learned only by long experience, and the roads to be built under this enlarged program will measure up to the needs and justify the expenditures only if there is available an adequate supply of engineers, contractors, superintendents and foremen. Engineering and contracting organizations with which we have been in touch in many parts of the country are urgently in need of the assistance of the specialists who left these organizations in order to join the 23rd Engineers. They were the men responsible for getting results in planning and in the field, and highway work is going to suffer severely if they are not here during the coming construction season to take charge of the new work.
>
> 2. In our publicity efforts to recruit the regiment we specifically stated, under direction of the recruiting officers, that only those men were wanted who were qualified to take charge of and to direct work, it being the expectation that prisoners and work regiments would be assigned to work under the men recruited in the 23rd.
>
> 3. While many of these men will find positions in highway work should they return after the construction season is well under way, naturally highway departments and contractors will try to complete their organizations at the

very opening of the construction season. In justice to these men, therefore, who showed their loyalty to their country by volunteering for service in the 23rd, we believe that they should be assigned for immediate return.

General Black's answer to the above has already been outlined in the opening paragraphs of this article. It may be stated, however, that he added that there is no likelihood, in his opinion, based on his information from General Langfitt, General Pershing's Chief Engineer in France, of the early return to the United States of the 23rd, or of any of the other regiments containing road builders. General Black is having very great difficulty in getting back from France his own staff engineer officers whom he needs here badly. In many cases he is unsuccessful, the answer to his inquiries and to the inquiries of General March, the chief of staff, from France, being that the officers wanted are "needed in France." With the policy which creates this need, of course not General Black, General March, General Pershing or any other Army officer is concerned; that is solely within the jurisdiction of the administration.

Typical Letters

It may be useful to quote one or two typical letters concerning the 23rd, on which this investigation was based. The following, from one of the men in France, is quoted in part:

> Many thousand men, 85% of whom are experienced engineers, artisans, etc., in various occupations connected with the construction business, enlisted voluntarily in the 23rd Engineers for immediate service in France, with the understanding that men skilled in their particular business were urgently needed at the front. Your advertising stated particularly that only experienced men were wanted, and not pick-and-shovel men.
>
> After spending five months in the United States this regiment was sent to France where, with the exception of the truck companies which are a part of the organization, fully 85% of these men have been since engaged constantly in nothing but pick-and-shovel work. These men are still doing pick-and-shovel work and only in rare instances has a man been assigned to the work for which he enlisted.
>
> It seems to me that a grave injustice has been done, not only to these men who voluntarily gave up positions of trust and confidence and made many sacrifices for the great cause, but to the country at large, and more particularly to the conduct of the war, by taking these men from occupations requiring skill and experience and placing them at common labor.
>
> A still more grave injustice will be done to those men if they are not returned to the United States by Apr. 15 or May 1 in time to take part in the season's activities in the world of practical construction.
>
> These men are nearly all experienced, practical engineers and skilled workmen. They are still doing pick-and-shovel work in France. They gave their services voluntarily.
>
> Do you not think that something should be done about it?

The following is from an employer in this country, interested in the return of the road builders, quoted in part:

> I am sending you an extract from a letter received from a civil engineer in the 23rd Engineers, U. S. A., which speaks for itself. It looks as if it were up to you to urge the War Department to consider their early return. The extract is as follows:
>
> > "We sure are in a nice position here in France. We are in the intermediate section between the Army of Occupation and the S. O. S. Nobody knows where we are and I guess nobody at home is bothering Army officials as to when the 23rd Engineers is going to be shipped home, as we don't come from any one locality as a regular division does. I guess General Pershing thinks we have gone home. Just a brief word as to the gigantic undertookings we are undertaking. Yesterday I saw a $250 a month man peeling spuds. Today he was sawing wood to cook the spuds, and tomorrow I suppose he will be helping to dump the peelings on the garbage pile. That's what about 150 of us are doing. The rest are chasing niggers and hunting cooties and rabbits in their spare moments.
> >
> > "The point is, in this regiment there are some 3500 good skilled men in various branches just stagnating over here. We, of all people, are not needed here at all. We were a technical, I was going to say *regiment*, but I supply the proper word, *mistake*, and not only that, we have been here and on the front for 12 long months, yet regiments and divisions over here, some only six months, are being sent home to gather together the shattered ends of their careers. I ask you, and through you those who may interest themselves in our return, aren't we entitled to a little consideration in the matter of an early return? I'm convinced that nothing can be done except from the home end.
> >
> > "The *Engineering News-Record* threw tons of ink and paper around getting us into this and praising this regiment to the skies as being composed of such highly paid engineers, yet never a peep out of them today about getting these highly trained volunteer engineers home. Of course we did not come over here for the *Engineering News-Record* but it was through their call we responded, and now that it is over I think it is up to them to demand our early return. The only time we have ever begun to use the talent in this company is here, and that in making ourselves comfortable."

It appears to me as if there ought to be some agitation to get these boys home without delay. They were sent right out to the front a couple of weeks after they landed in France and worked on the roads under shell-fire until the armistice was signed. A lot of them are men who left good positions here and worked with pick and shovel through the campaign. They did not mind that while the war was on, but now they rightly think they ought to be released.

This is a plain statement of what is being said and done in various quarters as to the 23rd Engineers, except that it is necessary to add that no explanation is obtainable in Washington as to why the men were promised by Army officers that they would not be obliged to do pick-and-shovel work and that they are, and it ought to be said that the statement would not be a well-rounded whole if it did not contain the following explanation. It is a fact that the War Department in Washington does not specify the units which are to come home or the order in which they are to come, and that the first information the War Department has concerning which units are to come home and the order of their coming is received by cable from General Pershing. The policy on which that is based is due to the fact that upon the signing of the armistice the War Department was besieged by politicians in the United States demanding the early return of their own home contingents. To get out of that political tangle the whole matter of the order in which units should come home was left to General Pershing, who, in turn, adopted the policy that the units which could be spared first should come home in the order in which they went abroad. In other words, those who went overseas first should come home first, bearing in mind the need for their respective services in France, based on the policy of the administration. Inquiry in Washington does not seem to develop any prospect that there will be undue delay in sending home engineers recruited from many states simply because they have no one single spokesman, and the case of the Rainbow Division, recruited from many states, and now on the way home, is cited as proof that there is no such likelihood.

New Orleans Army Base Improves Facilities of the Port

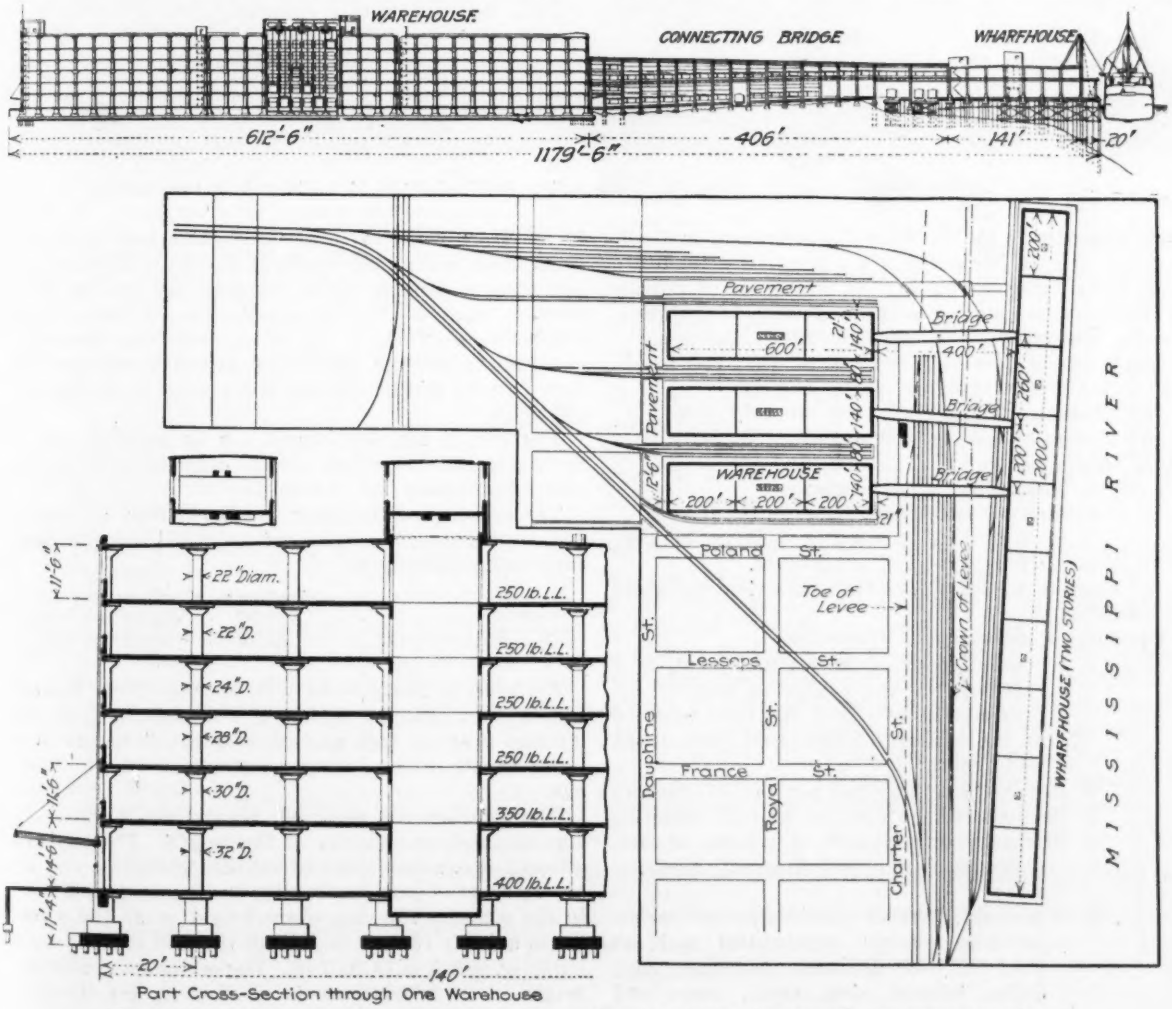
Three Concrete Warehouses Tied to 2000-Foot Wharfhouse on River by Bridges Permitting Access to All Floors — Rail and Water Connections and Storage Facilities Make Peace-Time Use Important

By George H. Davis
Ford, Bacon & Davis, Supervising Engineers

ARMY supply bases for the storage and transshipment of overseas freight to the Expeditionary Forces were located, rather late in the war, at Boston, Brooklyn, Norfolk, Philadelphia, Charleston and New Orleans. Of these the projects at Boston, Brooklyn and New Orleans are for permanent structures designed primarily for the war use but so located and arranged as to make them valuable additions to the peace-time operations of the port. The Boston and Brooklyn bases have already been described in *Engineering News-Record*. The New Orleans base, still under construction, is the subject of this article.

As shown on the accompanying plans, the plant covers an area of more than 48 acres, including various structures and yards, and is composed of three reinforced-concrete warehouse units of the same design, each 600 ft. long, 140 ft. wide and six stories in height, with two-story steel and pile wharf and wharfhouse 2000 ft. long and 140 ft. wide with connecting bridges joining the wharfhouse with the warehouse units. The connecting bridges are of structural steel of the inclosed multiple-deck type, spanning Chartres St. and the intervening railroad yards. There are approximately nine miles of single-track railroad serving the plant. The yards accommodate 520 cars, the warehouse units 135 cars and the wharf 88 cars, a total of 743. The total floor space of the three warehouse units is 35 acres, and of the two-story wharfhouse 13 acres, a total storage area of 48 acres. It will be noted that the floor area is the same as the ground area of the site. If all of the floor area of the structures were loaded to capacity the plant would contain more than 178,500 tons of freight for shipping, equivalent to more than 10 days' average movement over all the wharves, private and state, in the port of New Orleans.

The wharf is of sufficient length to accommodate at



Part Cross-Section through One Warehouse

PLAN AND ELEVATIONS OF THE ARMY SUPPLY BASE ON THE MISSISSIPPI AT NEW ORLEANS

first-off anchorage five to eight oceangoing ships simultaneously, and similarly the trackage immediately adjacent to the warehouse platforms, as previously stated, will conveniently accommodate more than 135 standard box cars.

Comparative Cost—The plant, including the yards, warehouse units, wharf and wharfhouse with complete equipment, will cost approximately $15,000,000. This is 1.2 times the cost of all the state and municipal port improvements on the river front made to recent dates, including the grain elevator plant and wharf, the cotton warehouses and wharf, the Public Belt R.R. and yards, and all the miscellaneous state-owned wharves.

The advantages to the City of New Orleans of this great expenditure by the Federal Government are self-evident. It goes further than any previous expenditure toward the fixing at this port of the center of gravity of concentration, storage and distribution of commodities for Western nations, especially South America.

The plant includes such features of design as are in use in the world's greatest ports, namely:

(a) Extensive storage capacity at ship side;

(b) Maximum loading and unloading capacity in a ship's length due to:

1. Double-deck wharfhouse;
2. Multiple-story warehouse units, and
3. Multiple-deck connecting bridges between wharfhouse and warehouses.

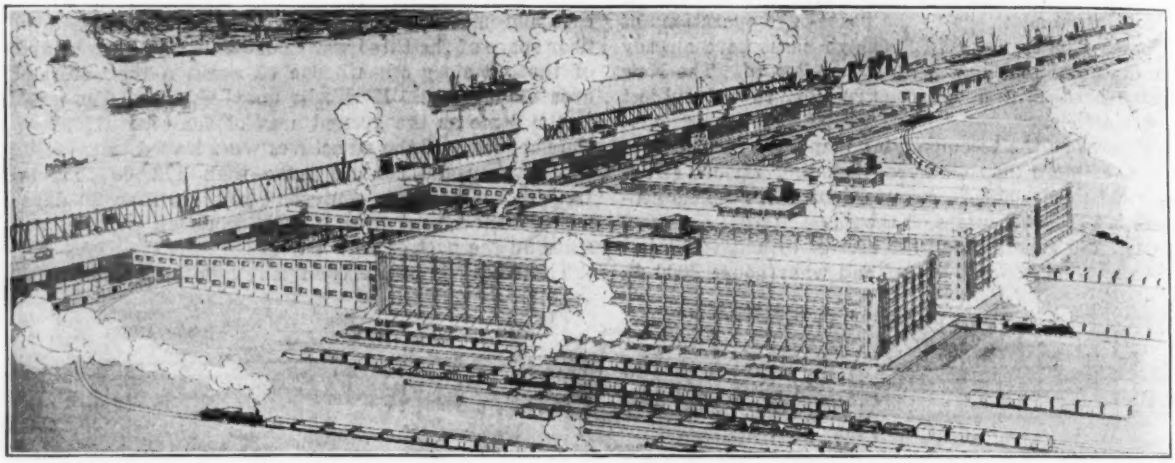
(c) Loading, unloading and transportation appliances as described.

Commercial Advantages—These are:

1. Increased speed in freight movement, thus reducing the ship's time in port by approximately 40% over the time required at the ordinary single-story unequipped wharfhouse;
2. Reduced handling cost per ton of freight;
3. Reduced storage cost per unit of capacity;
4. Reduced insurance costs on account of compartment design and fireproof construction;
5. A probable further classification of harbor facilities placing commodities such as steel and iron products, petroleum, coal, coffee, tobacco, sisal, grain, sugar and cotton at definite locations.

This warehousing, handling and shipping plant is of standard design and completely adapted to (a) the storage, transfer and loading of miscellaneous and standard package commodities; (b) both import and export transfer and storage, and (c) use as manufacturing lofts and factory machinery housing. The warehouses and wharfhouse have a column spacing of 20-ft. centers and an external glass area of 33% and 11%, respectively, being completely lighted for all the purposes noted before.

As stated, the warehouses are built for war or peace requirements of the Army as well as both public and private warehousing. Coffee merchants of Kansas City, Chicago or Denver can have their consigned coffee transferred from ships to these warehouses and from the warehouses to their customers in Memphis, Birmingham or Dallas, without handling the coffee beyond the port-of-entry storage. This is equally true of virtually all commodities. Tobacco can be shipped from Kentucky and held in storage for curing at the warehouses at New Orleans while sales are being made in Europe or elsewhere.



ARCHITECT'S PERSPECTIVE SHOWS NEW ORLEANS ARMY BASE AS IT WILL LOOK WHEN COMPLETED

The use of the warehouses can be extended so as to supplement the private storage capacity of all wholesale businesses.

The capacity of the plant is 178,500 tons, as stated, and in standard packages of principal imports and exports its capacity is:

	Warehouses	Wharfhouse	Total
Coffee (bags)	2,400,000	1,000,000	3,400,000
Sisal (bales)	350,000	150,000	500,000
Cotton (bales)	400,000	200,000	600,000
Tobacco (hogsheads)	100,000	50,000	150,000

Features of Design—As will be noted from the attached drawings, the design of the plant and its individual units is such as best to adapt it to use in a river harbor necessitating longitudinal wharf frontage.

The buildings are relatively narrow, the width being approximately one-quarter of the length. This feature allows a maximum length of railroad platforms and an arrangement of yard and loading trackage perpendicular to the wharf. The clear-story height of all the warehouse units is 10 ft. 8 in., except the first story in each building, which is 13 ft. 7 in. The minimum clear-story height in the wharfhouse is 17 ft. 6 in. for the first deck and 11 ft. for the second deck. The multiple-deck

structural steel bridges correspond in clear-story height with the joined buildings. The loading capacity on the various floors of the warehouse units is:

First	floor 400 lb. per square foot
Second	floor 350 lb. per square foot
Third	floor 250 lb. per square foot
Fourth	floor 250 lb. per square foot
Fifth	floor 250 lb. per square foot
Sixth	floor 250 lb. per square foot
Roof	25 lb. per square foot

The pile foundations of units No. 1 and No. 3 are designed for the total dead load and 85% of the live load, using a dead load of 12 tons per pile.

Under unit No. 2, to avoid the great difficulties and consequent delays of excavation, the standard piles in units No. 1 and No. 3 were replaced by composite piles, the lower section, approximately 48 ft., being of untreated timber, the upper section, approximately 8 ft., being of concrete installed in accordance with the design and under the supervision of the Raymond Concrete Pile Co. These piles are designed to sustain 16 tons.

The columns are designed for full dead loads and the following percentages of live loads:

Roof	100%
Sixth floor	85%
Fifth floor	80%
Fourth floor	75%
Third floor	70%
Second floor	65%
First floor	60%

The warehouse units are of reinforced concrete throughout. The structural design of the buildings is in accordance with the Chicago Building Ordinance, with exceptions as follows:

A. Flat-Slab Design:
1. The positive moments in bands perpendicular to the wall in the wall panels are 20% greater than for interior panels.
2. The negative reinforcement perpendicular to the walls and wall panels for the bands at columns is the same in amount as the negative reinforcement over the interior columns.
3. All negative reinforcing steel perpendicular to the walls is hooked 6 inches.

B. Beams:
1. Continuous beams are designed for the clear span.
2. The spandrel walls are self-supporting.
3. Lintels supporting the flat-slab floors are designed to carry the full dead and live load of one-fifth of the panel width tributary to same, considered as a uniform load.
4. Negative reinforcing bars in end spans are hooked 6 inches.

C. Spiral Columns:
1. The Considère formula is used in computing spiral columns.
2. The average core stress does not exceed 1200 lb. per square inch.
3. The concrete stress is 700 lb. per square inch for 1:2:4 concrete.
4. The amount of spiral reinforcement is not less than ¼% of the core area nor greater than 1¼ per cent.
5. The amount of vertical reinforcement is not less than 1% of the core area and not more than 4 per cent.

D. Laced Columns:
1. The concrete stress is 500 lb. per square inch for 1:2:4 concrete.
2. Lacings are not less than ¾ in. in diameter and they are spaced not more than 12-in. centers.
3. The amount of vertical reinforcement is not less than 1% of the effective area of the column nor greater than 4 per cent.

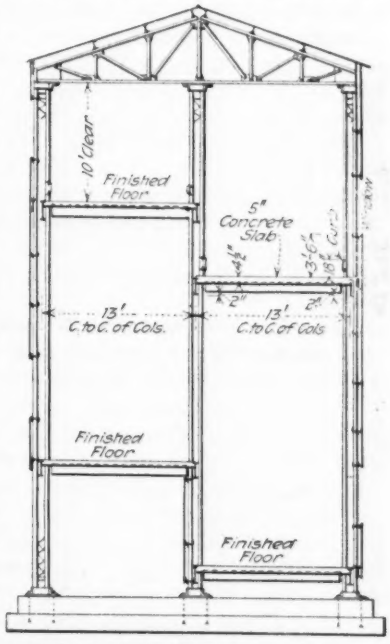
E. Concrete Stresses:
1. The extreme fiber stress for concrete in slabs and beams is not greater than 700 lb. per square inch for 1:2:4 concrete.

F. Steel Stresses:
1. Steel stress for tensile reinforcement for beams and slabs does not exceed 16,000 lb. per square inch.
2. Steel stress for tension in beam stirrups does not exceed 12,000 lb. per square inch.

G. Temperature Reinforcement:
The amount of temperature reinforcement is not less than ¾ per cent.

All other features of construction are in general accordance with standard specifications.

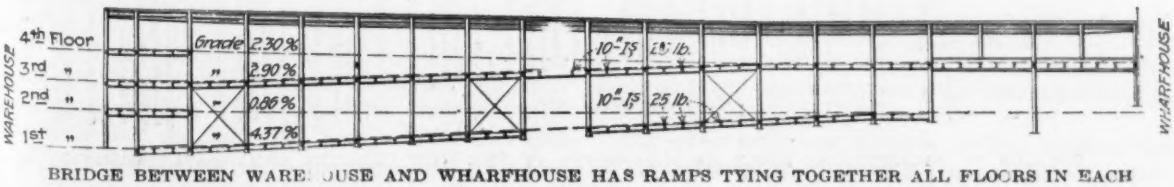
Piling is of round yellow pine and of various lengths for various parts of the plant. Under the warehouse units the points of the piles rest in a sand stratum at approximately —28 (Cairo Datum) giving a total penetration of approximately 51 ft. The piles are driven for the entire length through Mississippi River alluvial deposit until they bring up at the sand stratum before mentioned. Under the wharfhouse all piles and all exposed timbers are treated with 16 lb. of creosote oil per cubic foot. These piles range in length from 50 to 120 ft. In general, piles longer than 100 ft. are spliced, the lower portion being of plain timber and the upper of treated timber.



CROSS-SECTION THROUGH ONE OF THE CONNECTING BRIDGES

The cement is of standard brands of American portland cement. The fine aggregate is obtained locally and is limited in size to ¼ in. in diameter. The coarse aggregate consists of river gravel obtained from various sources, of sizes between ¼ and 1½ in. Concrete mix, except in special locations, is of 1:2:4 proportions.

The wharf is of treated and untreated timber, upon which is superimposed the wharfhouse of structural steel, inclosed by corrugated steel and rolling doors.



BRIDGE BETWEEN WAREHOUSE AND WHARFHOUSE HAS RAMPS TYING TOGETHER ALL FLOORS IN EACH

The plant is completely equipped for fire protection with sprinkler system and auxiliary appliances. It is lighted by electricity and heated by steam. The sewerage and drainage systems are in accordance with standard ordinances of the municipality.

As shown in the perspective a multiple-story bridge connects warehouse No. 1 with the wharfhouse. This structure has four ramps—that is, the first and second floors of the warehouse are connected to the first floor of the wharfhouse, and the third and fourth floors of the warehouse are connected to the second floor of the wharfhouse. The bridges connecting warehouses No. 2 and No. 3 each with the wharfhouse will be of two levels, extending from the third and fourth floors only of each warehouse to the second floor of the wharfhouse. Small bascule bridges close the railroad track openings in connecting bridge No. 1. Each consists of two leaves hinged at the outer end and electrically operated by a cable attached to a drum driven by a 10-hp. motor. Signals and brakes insure safe operation.

Handling Apparatus—Elevators for freight and passenger service are as follows:

	Wharfhouse	Warehouses
Number	5 freight	15 freight 3 passenger
Location	1 every 400 ft.	5 freight 1 passenger in center of each building
Capacity	10,000 lb.	10,000 lb.
Speed	100 ft. per minute (freight)	150 ft. per minute (freight) 250 ft. per minute (passenger)
Floor area	785 sq.ft.	2295 sq.ft. (freight) 126 sq.ft. (passenger)

Space has been arranged for one additional freight and one passenger elevator in each warehouse. Provision has been made for spiral chutes for the discharge of commodities. The transfer of freight longitudinally is by means of electric tractors and trailers and the use of hand trucks. Bridges are so designed that a minimum use of the elevator system will be required, on account of the three bridges connecting the wharfhouse and the warehouses.

Quantities of some of the more important items required for this plant are as follows:

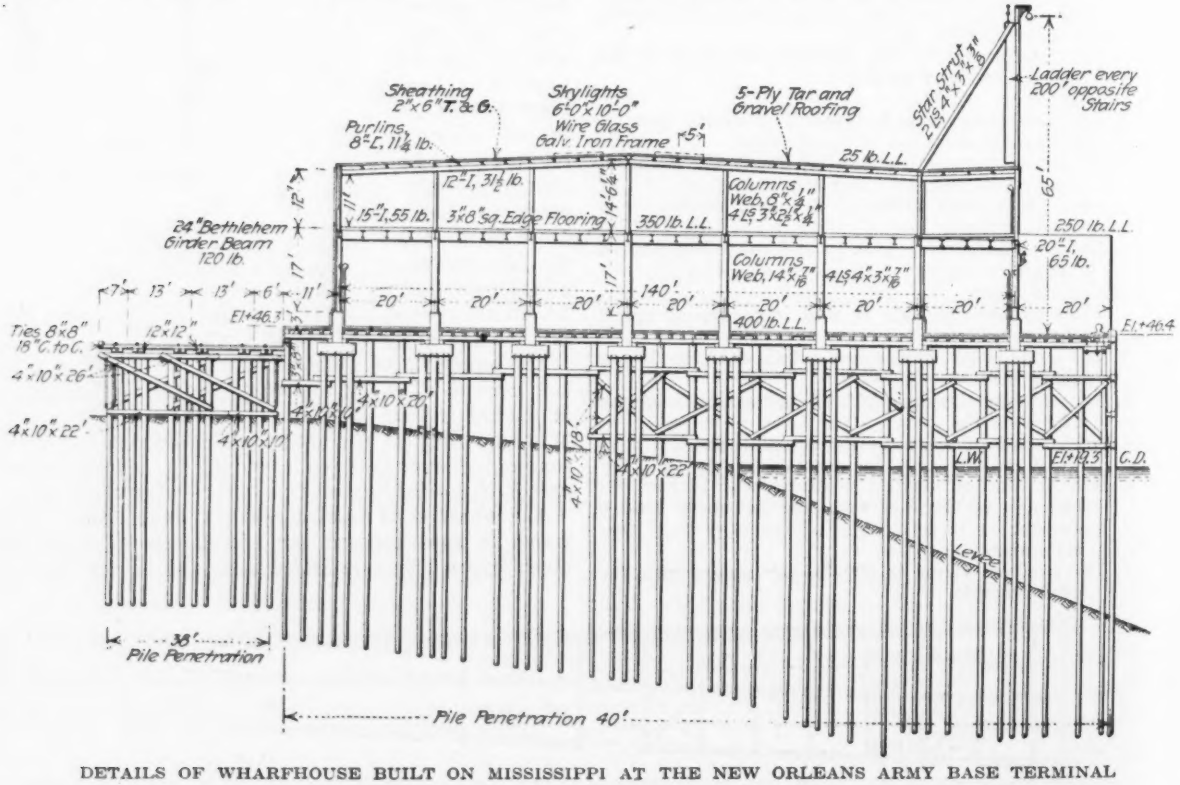
Warehouses

Number of piles	31,700
Cu.yd. of sand	48,000
Cu.yd. of gravel	93,000
Bbl. of cement	162,000
Cu.yd. of concrete	108,000
Tons of reinforcing steel	7,500
Ft.b.m. form lumber	9,000,000
Sq.ft. steel sash	113,000
Sq.ft. of roofing	252,000

Wharf and Wharfhouse

Number of creosoted piles	21,000
Feet, b. m., creosoted timber	5,000,000
Feet, b. m., untreated timber	2,000,000
Lb. structural steel	9,000,000
Sq.ft. corrugated steel siding	96,000
Sq.yd. creosoted wood-block flooring	37,000
Sq.ft. roofing	280,000
Sq.ft. steel sash	16,000

The construction of the New Orleans Army supply base is under the general supervision of Brig. Gen. R. C. Marshall, Jr., U. S. A., chief of the Construction Division of the Army, and in direct charge of Maj. A. Pearson Hoover, constructing quartermaster, who went direct from the Boston Army supply base. Ford, Bacon & Davis are supervising engineers of the base. This firm is represented by George H. Davis, member of the firm; Charles J. Hardy, New Orleans resident engineer, and Frank J. Trelease, engineer-in-charge. The George A. Fuller Co. is general contractor for the entire work and is represented by Walter T. Smith, vice-president of the company. The wharf and wharfhouse construction was sublet by the general contractor to Holbrook, Cabot and Rollins, of Boston.



DETAILS OF WHARFHOUSE BUILT ON MISSISSIPPI AT THE NEW ORLEANS ARMY BASE TERMINAL

How Educational Reconstruction Should Develop

Modern American Engineering Education Must Become More Effectively Concrete in Application of Theory to Practice

By L. W. W. Morrow

Assistant Professor of Electrical Engineering, Sheffield Scientific School, Yale University, New Haven, Conn.

RECONSTRUCTION problems are the most important subjects now being considered by the thinkers and workers of America. One of the greatest of these is the problem of educational reconstruction. The educational system of this country has been subjected to war conditions, and has experienced an almost revolutionary experiment. Educators are considering the past with the view of building for the future, hence a proposal for revolutionary changes in methods of engineering education is timely.

Modern American education was largely based on German educational systems and ideals. German schools and German educational methods were the patterns for the American system. Germany was the Mecca for graduate students. The past four years have shown a fruition of German educational ideals. The war has proved them utterly false and materialistic, however efficient. The German goal was materialism, and the foundations of the national idea, "Might makes right," were embedded in the educational system.

Not only has the war exploded the German educational bomb, but also it has subjected the educators of this country to an experience that rocked them on their foundations of academic seclusion and caused them to study critically pre-war educational methods.

The war first depleted the schools of students through the voluntary enlistment and then, before many schools were in financial straits, refilled the schools with soldiers to be trained for Army needs. The material for vocational training was largely obtained by selection from drafted men. The vocational and special training division of the Army existed sufficiently long to demonstrate its success. It accomplished its purpose and produced startling results in training men for Army needs under war conditions.

Problem Confronting Educators

The problem now confronting the schools may be divided as follows:

1. How to apply to civilian training the good elements of military training and the educational methods learned through war training.

2. How to remove German educational ideas and ideals from our schools and yet retain true educational efficiency.

3. How to educate future generations so as to maintain the present awakened civic conscience; to secure the spiritual element necessary for true culture and ideal civilization, and at the same time secure and maintain industrial and material preëminence.

4. How to coördinate and revise educational methods to secure a product better suited to the changed world conditions, and how to coördinate the educational system with civic and industrial life, in order that both may be vitalized.

What features of war training can be profitably incorporated in civilian training? Was the vocational training a success because of its methods, or because of the sense of duty and patriotism inculcated by the war spirit?

Concrete Application of Theory in Vocational Training

Vocational training has a definite goal. Every endeavor is to reach the goal in the shortest time. No time is given to extraneous subjects. Concentration and discipline are the keynotes of the work. The cornerstone of the educational method is the physical and concrete application of theory at the time when theory is studied. The student is taught to use his hands and his brain at the same time.

Green men carefully selected, fairly matured, capable, physically fit and mentally alert, with only high-school preparation, in 13 weeks have become well versed in radio-telegraphy from the theoretical and practical standpoint. This necessitated teaching them electricity and magnetism, direct currents, alternating currents, trigonometry and radio principles. After one month's work these men passed technical examinations equivalent to those given electrical engineering students at the end of their junior year. They obtained their knowledge through concentrated study and experimentation, under rigid military discipline.

Army training teaches that selection of material, discipline, concentration and the concrete are efficient aids to education.

The discipline is not that due to a uniform or to the manual of arms, but is the discipline that means self-control, promptness, thoroughness, self-reliance and a sense of responsibility and accountability.

Concentration means the intensive study of one thing at a time and mastering it before another subject is introduced. It means having a definite goal and bending every effort to reach that goal in the quickest time.

The concrete means studying a subject from the physical and applied standpoint. It means that theory follows experimentation, and that only that theory is used which has utilitarian applications. It means using experimentation and physical presentations to obtain knowledge.

How can we obtain true discipline in civilian training? Shall we introduce military training, and trust that discipline will result? Past experience has taught that a few hours' drill each week in no sense of the word inculcates true discipline. A more vital application must be made. There is a question whether military training is essential to proper discipline. Discipline can as readily be obtained through a tightening of our educational requirements. There was too much leniency and laxness in our pre-war educational system. For the proper development of the students, too much freedom from control is as bad as too rigid repression.

Educators can require promptness in students; they can hold students more rigidly to requirements; they can instill a nobler and broader idea of education in their students, and can by word and example exemplify and introduce true discipline.

The great difference between civilian training and Army training lies in the fact that the former has no

concrete goal, no fixed target at which to aim, as contrasted with the latter.

The object of an engineering school is to develop a product that will benefit society materially and socially, the material benefit being gained through the incorporation into industrial pursuits of workers well grounded in the natural sciences and capable of increasing their industrial applications, the social benefit being gained through the addition of men to the world's citizenship who are culturally developed and equipped with perspective, vision, and civic ideals such that a better civilization and citizenship will result.

In order to produce such a product the engineering school must afford the following facilities: (1) Instruction in the fundamental sciences underlying industrial applications; (2) an atmosphere and environment conducive to social idealism, cultural, and general development and true ideas of service and worth.

The student enters an engineering school with a development of codified knowledge and personality that is very meager. It is the function of the school to develop the personality of the student to its full extent through proper environment and educational supervision; to develop the codified knowledge of the student in every direction not only as regards engineering knowledge, but as regards the humanities, and in addition to accentuate his codified knowledge of engineering and of the special branch he elects.

The larger schools of this country have developed artificial divisions called departments. These divisions, too frequently, are independent entities and give their courses without any reference to the other departments also concerned with the education of the student. The mathematics, physics and chemistry departments have their own ideas as to the proper method of presenting their subjects, and the student is taught each subject as though it stood alone and were not coördinated with the other fundamental sciences. Too often each department tries to develop a specialist in the one science rather than to coördinate all the sciences in the mind of the student.

Such conditions make for inefficiency. The departments must be coördinated and must be subordinated to the fundamental idea of turning out a product with a sound and correlated knowledge of the fundamentals of engineering.

Eliminate Abstract Teaching

The concrete method of presentation is difficult to adopt in our educational systems. Tradition and precedent are overwhelmingly in favor of teaching fundamental science as an abstract rather than a concrete thing. Theory comes before practice. This is entirely artificial, and is due to taking the easiest way.

Engineering fundamentals should be taught in the applied manner, which involves the utter elimination of the abstract subjects called physics, chemistry, mathematics, etc., as such; the entire elimination of the abstract and the general in favor of the concrete and the applied; the introduction of experimentation as the direct road to knowledge; the giving of practice before theory rather than the converse; and the use of logic, psychology, and common sense in teaching.

All science is experimental and can best be taught from the experimental standpoint. The keynote of the applied method of teaching is to use the concrete to find out the *how* of things and follow with the *why* of things and thus conform to nature's educational method —first *see* what happens and then determine *why* it happens and *how much* it happens. This means that the abstract subjects, physics, mathematics, chemistry, etc., would be applied to a given experiment or piece of apparatus sufficiently to explain *why* and *how much* it happens and would coincidently bring into the instruction English and economics as applied to expressing and appraising the experiment and its results.

This necessitates a careful planning of experiments such that in an engineering course the student will have to apply all the abstract fundamentals of physics, chemistry, mathematics, mechanics, etc., before he has finished the experimental work of the four years. This involves a revolutionary change in educational methods and in the qualifications of engineering educators, for the experiments must not only bring out the fundamentals but must be interesting, practical and of an engineering nature.

In addition, this method implies a selection of the students for the engineering schools and the classification of these students into divisions of similar mental and engineering qualifications. A few simple psychological tests are more valuable for determining whether the prospective student is of engineering caliber than any stereotyped entrance examination—the latter requires only memorization, the former requires thinking and an attitude of mind essential to engineering success.

Administrative Remodeling Required

An education scheme of this nature would use all the equipment and teachers now available in our engineering schools, but would require an administrative remodeling of departments and a coördinated type of education rather difficult to administer.

The first requirement is a carefully planned series of experiments on concrete subjects in conformity with the subdivided engineering student classifications to insure an appropriate fundamental content. The second step would be the allotment of selected instructors to handle the classes in accordance with the engineering and personality classifications of the students. The third step would be the allotment of the classes to the different engineering and scientific laboratories.

The mathematics, economics, physics and mechanics departments would cease to exist as such and the chemistry department would be changed to chemical engineering, but the instructors, laboratories and equipment of these former departments would be utilized where needed for experimental or instructional purposes. *Abstract courses would be entirely eliminated, the student would take only one course classified by the engineering department elected, and his time would be allotted by coördinated faculty agreement.*

Every experience of life and industry teaches that real knowledge is best gained by using the hands and the brain at the same time. Any efficiency engineer handling labor will bear out the foregoing statement. Mathematics, physics, chemistry and mechanics must be taught as experimental, concrete and applied subjects, if real educational efficiency is to be attained.

Probably the greatest task in educational reconstruction is to maintain the present spiritual and idealistic attitude in the nation. The war has proved that efficiency solely in materialism means destruction. Ger-

many concentrated on the materialistic; industrial supremacy, martial supremacy and financial supremacy were her civic ideals, with no leavening of truth and idealism. The world needs no greater example of the falsity of such ideals. No civilization can exist that has not humanistic ideals as well as materialistic. The war has taught that future education can only be successful if it inculcates in the students a realizing sense of the importance of idealism and true culture, as well as giving them sound training for preëminence in material pursuits. The humanities are as essential as the sciences in any true educational system.

The word "humanities," as generally accepted, means history, literature, art, etc. It is not necessary to teach Greek, Latin, art or literature to instill the true humanitarian spirit in students. As has recently been stated, "Greece was the only uneducated nation; yet every other nation has been educated by Greece"—meaning that Greece had no traditional history, literature or art to study, but developed her own culture. Greece cultivated her own humanities and culture, and they have been accepted by later nations as standards for emulation. Our humanities need not be those of Greece. Our education should develop the humanitarian spirit through developing in the nation conditions such as existed in Greece whereby spontaneous cultural development will occur.

Coöperation Needed

The day of the academic attitude in education has passed. Education must be reconstructed on the basis of the utmost coöperation between the schools and industry. The product of the schools supplies the demands of industry. Educators are needed in industry, not only on material grounds, but also because inherently they are the leaders in idealistic thought. Industrial men are needed in the schools, on the other hand, to train students properly and efficiently for industrial work.

Both the educators and the industrial men gained breadth and vision through their war experiences. The views and needs of industry became widely disseminated among educators, and, on the other hand, industrial men gained a truer knowledge of American educators and educational methods. Industry had need of pure scientific knowledge and gained it from the educators. Much of the pre-war antagonism and narrowness of view has disappeared. Every indication points to a more intense educational and industrial coöperation. Industry will establish research scholarships; will use educators as consultants on labor and other industrial problems; will furnish competent men to help educate students for the needs of the industrial era—if properly encouraged to do so by American educators.

In addition to school-room work, the educational institution must furnish the facilities and environment for intellectual and moral growth. The teachers should be men who are respected and emulated by the students, they must be approachable and must be interested in the students. They must coöperate in student activities to the utmost and encourage all social and other non-scholastic activities that make for proper student development. Teaching should be a profession and not a side issue with research or commercial engineering the main issue. Teachers should be selected for their teaching ability rather than for their research and mathematical ability.

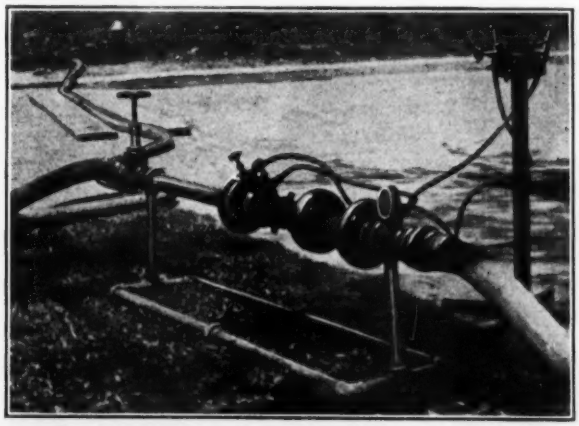
A proper application of the foregoing principles will increase the efficiency and value of engineering education, but no compromise plan will attain the results desired. The plan is difficult to carry out, but far from impossible. The war has revolutionized industry—reconstruction is the key-word of today. Nothing needs reconstruction more than engineering education.

Devices for Water-Waste Surveys at Oak Park, Illinois

Portable Venturi Meter to Test Pipe Districts—Pitometer Inserted in House Service Makes Leakage Charts

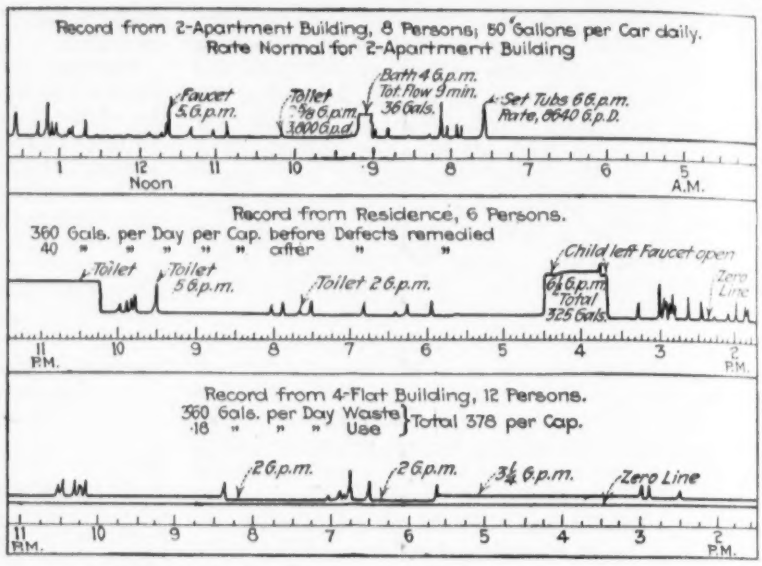
PRELIMINARY to a water-waste survey, it is advisable to make a rough pitometer test of the entire city, according to a paper read before the Western Society of Engineers by Herbert P. Matte, chief sanitary engineer of the Illinois State Department of Public Health. This is done by isolating certain districts by closing gate valves and then measuring the supply through one main left open. On small systems it is possible to make this test by shutting down those districts entirely for a few minutes, especially in the residential sections, and noting the drop in the rate of consumption as indicated by the recording chart at the master meter, providing it is on the distributing system.

In districts which are completely metered the velocity of the smallest feed main may be so low that it is impossible to obtain an accurate record of the consumption if there are no large leaks. It is then necessary to bypass the flow through a small pipe (2-in. or less) in order to increase the velocity. The most practical way of doing this is to feed from a fire hydrant outside the district through a fire hose to a hydrant within the district. A regular displacement meter may be used and the rate obtained by noting its readings at regular intervals, but this method is not very useful owing to the fact that several drafts may occur during the test. Two methods used at Oak Park, Ill., are described by Mr. Matte. One consists of a 2-in. venturi meter with a ⅝-in. throat which can accurately record rates from 3 to 50 gal. a minute. This is shown in the accompanying



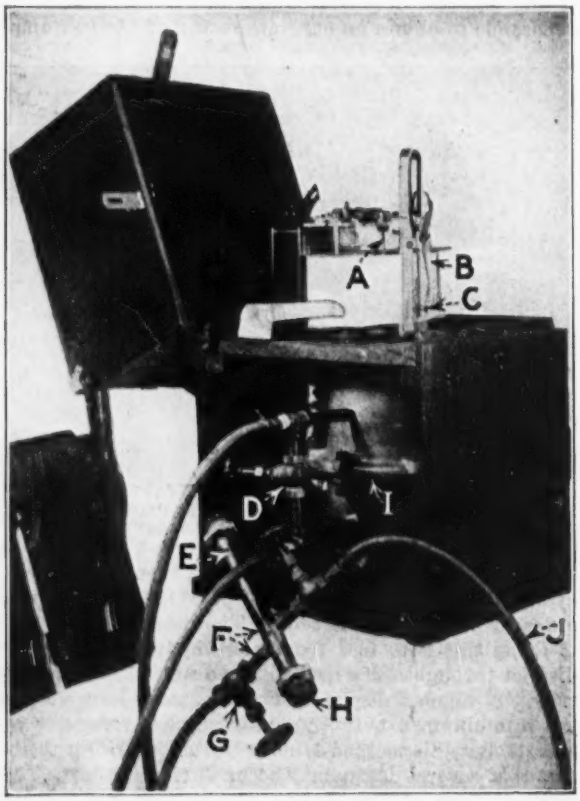
PORTABLE VENTURI METER WITH BAROMETRIC MERCURY MANOMETER FOR WATER-WASTE TESTS

view. The other is by using pitometers inserted into short pieces of pipe, 2-in. or smaller. This permits the measurement of as low as ¼ gal. per minute. Contrary to the usual method, all the Oak Park tests were made during the day, after determining the hours in which the flow was somewhat steady. The districts varied between one-quarter of a mile and two miles in length. As the rate of consumption could be watched, it was rarely found necessary to be on the job for more than half an hour at a time in order to determine the minimum rate of consumption. The population of the district was obtained from the school census, and the average daily consumption through the domestic meters was obtained from the water accounts. Thus, an estimate of the legitimate rate exclusive of the underground leakage was determined. Where there was not much leakage the normal pressure was maintained through 600 ft. of fire hose. Where the flow was abnormal, the valve on the meter was throttled, in order to bring the reading within the limits of the manometer.


Record from 2-Apartment Building, 8 Persons; 50 Gallons per Car daily.
Rate Normal for 2-Apartment Building
Faucet 5.6 p.m.
Toilet 3.6 p.m. 3000 G.p.d.
Bath 4.6 p.m. Tot. Flow 9 min. 36 Gals.
Set Tubs 6.6 p.m. Rate, 8640 G.p.d.
1 12 11 10 9 8 7 6 5
Noon A.M.
Record from Residence, 6 Persons.
360 Gals. per Day per Cap. before Defects remedied
40 " " " " " after " "
Toilet
Toilet 5.6 p.m.
Toilet 2.6 p.m.
Child left Faucet open
6½ 6 p.m. Total 325 Gals.
Zero Line
11 10 9 8 7 6 5 4 3 2
P.M. P.M.
Record from 4-Flat Building, 12 Persons.
360 Gals. per Day Waste
18 " " " Use
Total 378 per Cap.
2 6 p.m.
2 6 p.m.
3¼ 6 p.m.
Zero Line
11 10 9 8 7 6 5 4 3 2
P.M. P.M.

SAMPLE OF CHARTS FROM WATER-WASTE DETECTOR

A rate of 60,000 gal. per day at 10-lb. pressure in a pipe only half a mile long was observed in one case, the normal pressure in the mains being 45 lb. Tests by the aquaphone disclosed six service leaks which wasted 200,000 gal. a day. This meant a leakage rate of 305 gal. per capita per day, while the service meters indicated only a total per capita consumption of 45 gal. After repairs were made the leakage rate dropped to 10 gal. a day.



DETECTOR FOR DOMESTIC WATER WASTE

A, rod to diaphragm; B, paper 2½ in. wide; C, pen; D, bypass; E, ¾-inch brass meter nipple; F, pitot tubes; G, ¼-inch needle valves; H, threads for ¾-inch meter couplings; I, diaphragm; J, pressure tube.

To determine the cause of high water bills where there was no leakage and the consumer was sure he was not wasting water, the water department at Oak Park designed a recording detector or pitometer, which, when substituted for the meter, gives a graphic record of the consumption for 24 hours or a week. This device consists of a piece of ½- or ¾-in. brass pipe 7 in. long, into which are inserted two $\frac{1}{16}$-in. brass pitot tubes, one pointed upstream and the other perpendicular to the axis of the pipe. For convenience, these tubes are soldered into ¼-in. brass nipples. Two needle valves and strong rubber tubing complete the detector, which is inserted into the house service either in place of or tandem with the meter.

A special type of recorder with a rapidly revolving chart, so that drafts lasting only ½ min. could be detected, indicated at what time and how long faucets were left open for baths, for washing dishes or clothes, or for lawn sprinkling; how often toilets were flushed, etc., together with a record of all leakage of 1½ gal. a minute or more. Part of a sample chart is shown in one of the illustrations.

In the first experiments the pitot tubes were connected to a mercury U-tube, by means of which rates ranging from less than ½ gal. per minute to 30 gal. per minute were measured by using the ½-in. and ¾-in. nipples. A camera provided with a 3-in. revolving sheet of bromide paper was adjusted so that the lens magnified the deflections through a slot about 0.008 in. wide. A pocket flashlight supplied the illumination, through a condenser, and the power was furnished by a single cell storage battery constructed for the purpose. The only drawback was that the high deflections were beyond the range of the slot, although small leakage was detected which the disk meter failed to record.

After fruitless attempts to alter the quantitative measuring device of the displacement meter so that

it would register in gallons per minute, the next step was to design a recorder which could take care of all flows. This new recorder, shown in one of the illustrations, will detect rates as low as 1½ gal. per minute, and there is no limit to the maximum recording capacity if larger meter tubes with lower center velocities are used. The diaphragm is constructed of ⅛-in. mechanical rubber, and Mr. Matte states that it was surprising to note the power transmitted through the stuffing box. The recovery after a short draft is rapid, even at maximum velocities, as indicated by the accompanying drawing of actual records. The recorder is not extremely accurate, but frequent rating by means of the regular meter-testing outfit indicates that it is amply dependable. It has been used successfully, in connection with a 2-in. venturi meter, in making waste surveys by means of the hydrant and hose method described above, and gives much assistance in determining the varying consumption in the district tested so that the leakage can be ascertained.

Comparison of Long and Short Highway Contracts

Opportunity for Both—Outgrown Methods Should Be Discarded—Long Contracts Cheaper and Desirable to Attract Large Construction Organizations

By H. Eltinge Breed
First Deputy Commissioner of Highways, New York State

EVIDENCES indicate that highway work offers the biggest immediate opportunity to all kinds of contractors, both large and small. For the present needs there is a scarcity of experienced highway builders, and the attraction of large construction organizations experienced in other fields will depend largely on the sizes of the contracts available. Comparison of the relative cost of letting a long stretch of road by one contract, or by several contracts, shows a large saving for the former procedure, if proper precautions are taken in organization and in the selection of the plant. More economical distribution of materials and plant, without disturbing the work of other contractors on an adjoining site, is also to be expected. While many lines of private enterprise still falter in uncertainty, there is urgent need for highway work and the means to satisfy this need are at hand. So great is the opportunity that there is danger lest is be wasted by trying to hold the future to the routine of the past. Now is the time to shape larger means to greater ends, and to advance fearlessly beyond outgrown practice.

Large amounts of money are available for highway work, and public opinion is favorable to such expenditures. Two hundred millions—and more to follow—have been appropriated by the Federal Government; $50,000,000 and $60,000,000 bond issues have been passed in Pennsylvania and Illinois, respectively, and large appropriations have been made by many other states. Public sentiment, roused by the transportation experiences of the past two years, is solidly behind road construction, and is being intensified through nation-wide propaganda conducted by good roads and automobile organizations, chambers of commerce, and material and motor-car interests, while labor of all kinds demands productive employment that will hasten the readjustment of conditions.

Future Progress Threatened

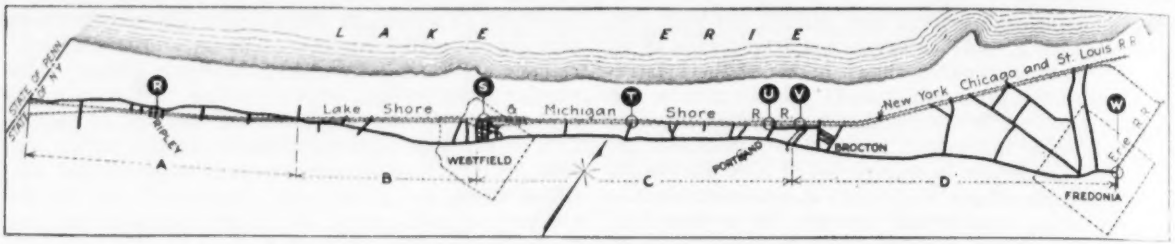
Nothing threatens our progress in the future more gravely than the practice of letting all contracts in lengths averaging one to five miles. This has encouraged the man with small capital and a one- or two-unit plant to enter the field, and to his initiative and courage our roads today owe much. But it has practically excluded large organizations which, figuring other contracts in terms of millions, could not afford a shift to such small game as the highways have offered. The reasons for the short contract are obvious: Tradition, from the days when highway contract work was trifling and uncertain; red tape, which has tied up with legal restrictions getting work done; fear felt by the small man lest he be crowded out by a more powerful competitor; and the reluctance hitherto of large concerns to enter highway work because they were not sure that it offered sufficient opportunity for a large capital investment in plant.

Scarcity of Contractors

As the matter now stands there are not enough contractors available for work advertised on the short-contract basis. In New York State there are 600 miles of abandoned and new contracts ready for letting, which require, for plant and backing, a contracting capital of about $2,000,000. Of the 554 formerly listed, there are now only about 100 going contractors in the state equipped for highway work, with an estimated total capital of $1,000,000. Not even all of these are available for new work, as some already have all they can handle. And this in the state where the extension of highway work has attracted most men into the business. We must have more men for the actual construction work. The length of our contracts will determine to a large extent whether these men shall all be comparatively small beginners in contracting or whether large and experienced organizations shall be included.

One thing is certain—long stretches of work will be let at one time. We now see our highways in terms of national systems instead of as convenient spurs to the barns of local politicians. We plan highways that shall traverse the country, north and south, east and west. A route shall cross one state and connect with the corresponding route in an adjacent state. A very few of these routes are already completed, of others only short gaps are to be built, but the majority, in stretches from 20 to 80 miles, still exist only in blueprint plans. Shall such stretches be broken up into sections or advertised for one bid?

Let us consider an actual, concrete case. Route No. 18 of the New York State highway system, shown in the accompanying sketch, runs from the Pennsylvania State line northeasterly along the New York Central & Hudson River R.R. to Fredonia. The distance is 25.76



HAULING DIAGRAM FOR ROUTE NO. 18 FROM THE PENNSYLVANIA STATE LINE TO FREDONIA, N. Y.
R, S, T, U, V and W show railroad sidings

miles. The engineer's estimate for a concrete pavement 16 ft. wide and an average depth of 6 in., at present prices, would be $800,000.

Consider this divided, according to the old practice into four contracts as follows:

State line to Forsythe	6.74 miles, Contract A
Forsythe to Westfield	4.02 miles, Contract B
Westfield to Brockton West Corporation line	7.65 miles, Contract C
Brockton West Corporation line to Fredonia	7.35 miles, Contract D

Then consider the whole distance from the state line to Fredonia in one contract lettered A-D.

For close comparison let us plant the one large contract and the four short ones with the same kind of equipment. Plant has been figured on the basis of completing the road in one season.

The total cost of a plant, new, for Contract A-D is $139,100, with $6300 additional for supplementary plant.

Contract A requires $44,600 worth of new plant with $3300 for supplementary plant; Contract B requires $35,100 worth of new plant; Contract C requires $41,100 worth of new plant and $6300 for supplementary plant; Contract D requires $53,600 worth of new plant and $6300 for supplementary plant. Total cost of new plant for the four contracts, $174,400; total cost of supplementary plant $15,900—an increase in cost over plant for a single contract of $44,900. The season's additional cost of plant for the four contracts over the one contract is $13,414 plus $2112 for the supplementary plant. These totals were arrived at by figuring the interest charge at 6% on the basis of actual cost, plus 12% for repairs on regular plant and 6% for repairs on the supplementary plant, allowing 20% for depreciation on new plant, with an allowance of only 10% for depreciation on supplementary plant because it is used less.

We must also figure the approximate freight on this plant and the on-and-off charge of loading and unloading, as well as the moving charge for the four contracts, which amounts roughly to about $2000 more than that for the single contract. Thus, on the one item of plant alone we have saved through the one long contract $17,526.

Supplementary plant is necessary to insure the completion of the longer sections in the one working season. It would, of course, have been possible to have figured other kinds of plant, but the character of the plant used—concrete mixers, unloaders, rollers and motor trucks—is such as would show smallest depreciation and greatest salvage value.

The necessary motor equipment was figured on the basis of the actual quantities involved for the exact average haul. The planting of the job and the work was figured on the basis of three organizations for the large contract, with a possible supplementary organization to piece out any section running behind, while the small work was figured on the basis of four organizations, with the possible use of two supplementary organizations.

Without doubt, the organization and overhead charges for doing the work would be less in the long contract than in the four units that comprise it. Obviously, we cannot estimate here in exact figures, because these costs always depend upon the individual contractor and the individual organization. There are, however, certain advantages and disadvantages that would apply generally.

Interference of Short Contracts with Each Other

Suppose the long stretch of road cannot be as advantageously broken up as the one shown in our map. In order that his supplies may come freely to each contractor, a cross-road must traverse his contract, either near the middle or else at both ends. Should this be lacking he must either build one himself at consuming expense, or he must petition the adjacent contractor for permission to haul over his part of the road. This may or may not be granted for all or part of the time, and John Jones may get on his job some morning to find that the crushed stone for which all his force waits is held up for a week because his neighbor has just put in green concrete.

Three efficient contractors finish their jobs on schedule time; one weak brother gets his all torn up and has to leave it impassable till the next season. The one undone makes useless the three done. The public is incensed. Having learned the value of coördination, it begins to question the wisdom of four different concerns all doing the same job, of paying four overhead costs where one might suffice, of holding four persons instead of one responsible for completion and success.

The demand thus arises that long stretches of road, from 15 to 30 miles, be let in one contract, except in unusual cases where specialized construction work is involved. Suppose this is done with Route No. 18 to Fredonia. The contract is advertised and awarded to the Mammoth Construction Co. The bids have indicated one gain over the old plan; the work can be done at less cost to the public and probably with more profit to the contractor. Here are some other items of saving besides what we have already detailed in respect to plant:

1. The contract is limited to one season, as it could scarcely be with the four concerns. The public thus has the route completed in one year. The cash saving is from $500 to $1000 a mile—the extra charge which every good contractor adds to work carried over the winter season. Engineering charges also are always lessened, according to the rapidity with which work is completed.

2. The overhead cost of a large organization doing

a big piece of work decreases in proportion to the amount of work done. Men of higher grade can be employed to conduct the work. The broader scope will attract them, as well as the larger salaries justified by their increased responsibilities. Plant can be more economically employed. The large organization carries enough plant, so it is less likely that it will have to buy special equipment for any one job. This lowers its bid. All the plant is kept more continuously busy, so that a smaller amount need be charged off against that depreciating in idleness. There is less shifting of plant from place to place, because the same units will be kept on the long job throughout the season.

3. The greater power of a large organization makes for efficiency and economy. Materials bought in quantities cost less, and better service is obtained in their delivery. Labor is often more available for large organizations, because of their wider prestige. Financial strength means the ability to tackle the hard and often less remunerative part of the work at the beginning, without playing out of time for the "velvet."

4. Equipment for efficiency is justified in the large undertaking, even at great expense. It pays to build railroad sidings and spurs for freight haulage to a 25-mile contract, whereas for a short contract the hauling and unloading would have to be done by more costly methods.

Requirements of Large Contractors on Highway Work

If the large companies entering highway work already possess ordinary equipment, such as hand tools, plows, scrapers, wagons, drills, boilers and engines, pipe line and small pump, etc., they will have to buy such new machinery as the particular job requires. For water-bound imported-stone roads, this machinery will consist of an unloader, a roller, wagons or trucks, and a road machine; where local stone is used, a crusher and bin also, but not the unloader; for roads of bituminous macadam, penetration method, imported stone, the pipe line and small pump may be omitted and a bituminous-material distributor provided; for concrete roads, a concrete mixer, and, in addition, the same plant as for water-bound macadam. Additional wheelbarrows, finishing tools, forms, etc., are required also. Brick pavements require in addition a small roller and grout machine. For bituminous macadam mixed method, a hot mixer and an asphalt roller, and if on concrete foundation, the same equipment as for concrete pavement is required. It must always be remembered that the unloading and hauling equipment will depend upon the quantities involved and the length of the haul.

There are several dangers peculiar to the large organization. If it has had experience in railroad work, it is well prepared to run its organization extensively as well as intensively, but if its operations have been confined to limited areas such as are involved in structural buildings, dams, foundations, etc., it will have to learn that a road unrolls its length like a ribbon, and that the man at one end of it can see the other end only through the eye of his mind. This quality of imagination that visualizes the unseen is prerequisite in every highway engineer and contractor, and in every assistant in charge of work. Placed himself in one spot, he must be able to tell at any given moment exactly what is happening at every other spot in his domain. He must be able so to plan that every bit of work beyond his ken as well as within it dovetails neatly into the whole, without waste of energy or loss of time. Such organizing ability is essential to the success of any highway contract. Furthermore, because it is always moving on, road work requires a flexible organization and men with power of quick adaptation. The routine foreman who has succeeded in house building would probably be out of his element in highway work.

Experienced men well trained in highway work are scarce; they should and can command good salaries. Construction companies entering the field must scan their payrolls to see that the importance of a man's particular work is commensurate with the skill and the salary of the man who is doing it. Otherwise, they cheat themselves and also some other contractor who probably needs the man's services.

At every turn is the temptation to overplant the large contract simply because it is large, on the assumption that more work will be done. It won't. Instead, machine power will lie dormant and the human power involved will be wasted. On average highway work of excavating, grading, filling, subsurfacing and surfacing, there is needed one full unit of plant for about every five miles. More than that clutters.

Any successful construction company knows the necessity of keeping down the overhead expense. Nowhere does this show more tendency to soar than in highway work, just because of that extensiveness of which we have already spoken. The large companies will find it helpful to gather exact engineering cost data and to figure in advance all the details of every phase of their work. They will then be able to correlate expenses so as to keep within bounds.

One Argument Against Long Contracts

There is one argument against the letting of long contracts—that it will exclude the smaller men from competition. This objection may be met in several ways. We have seen that there is at present more highway work to be done than there are contractors to do it, and that it will be public gain and economy to attract large construction organizations to highway work by letting contracts for long distances. As the editorial in *Engineering News-Record* of Mar. 13, 1919, p. 503, on this subject suggested, there will be enough short stretches of road, one to ten miles long, to engage all reliable contractors with small units—connecting links, short spurs to newly developing centers of traffic, resurfacing for maintenance, etc. To secure the widest competition, however, contracts could be advertised for alternate bids. The Fredonia road, for example, could be advertised in one contract for large concerns, and it could be broken up and advertised in four contracts for the smaller competitors. If the total of their low bids for the work were lower than the lowest single bid for the whole piece, then the work would be let in four contracts. I think that would be improbable, if the big concerns were making reasonable bids.

Where it would be very probable is in spurs to be built radiating like spokes from any large center as a hub. Suppose Fredonia to be such a center, with roads of permanent type leading from it five to ten miles in ten different directions. All of these could be included in one contract, and also each one could be advertised in a separate contract. It would be an interesting experiment in organization for the big con-

cern to try such a contract, with one central force in the city directing all its activities along the ten spurs. I believe it would be tremendously successful. But the smaller contractors would stand a good chance of winning their separate contracts and proceeding just as they do today. Another element would thus be added to the contracting game, played by men who are born lovers of hazard—or they wouldn't be contractors.

The alternative brings with it an opportunity for the smaller men. Their logical progression now is from one to two to three and four or more contracts. These may be scattered all over the state, so that the contractor loses all sense of coherence and spends much valuable time going from one job to another. His success will bring greater rewards, when, instead of bringing more jobs, it will add simply more miles to the one job, and leave him still with a definite center of gravity. He too will bless the long contract.

SOCIETY SERVICE

A Section Dealing with
the Results of Teamwork by Technical Men

Philadelphia Club Maintains Membership by Broad Policies

The Philadelphia Engineers' Club some years ago, through a vigorous campaign, built up a large membership. Despite the war, that membership has been well maintained and the club has continued to prosper, both financially and as a social and intellectual center for the engineers of Philadelphia. Much of the success is due to the very broad policies adopted with reference to affiliated members and to the vigor and resourcefulness of the house and entertainment committees.

At present there are 1800 active members and 600 juniors and associates, giving a total membership of 2400. In addition, there are about 1000 affiliates. These affiliates are members of local sections of national engineering societies which have the privilege of holding their meetings at the clubhouse. For these privileges the sections pay to the club $1.50 a year for each of their members, and those not holding club membership are thereby constituted affiliates and get the club's monthly journal, a vigorous, well printed, well conducted organ. It costs more than $1.50 a year to send the journal to the affiliates, but the club regards its loss in this direction as the cost of advertising, as it conveys monthly to these affiliates the news as to the activities of the club, and thus serves to bring the desirable men into active membership.

As an indication of the vigor of the entertainment committee may be cited the means employed for obtaining a large daily use of the luncheon facilities of the club. An average of 65 engineers is found there every noon-time. When it was discovered that Tuesday was a small day, the entertainment committee made arrangements for Tuesday luncheon talks. Thursday, for some reason, was found to be a low day also, and therefore a special menu is always arranged for Thursday, while music is provided on Saturdays. There is a ladies' dining-room, for the wives, sisters and daughters of the members, and this dining-room is used to full capacity every noon.

Every second week there is a smoker with a paper or a "movie" on some more or less popular topic. The technical activities are provided by the local sections of national engineering societies, and there are so many of these that there are technical meetings every week. Saturday afternoon trips are arranged, during good weather, at least every other Saturday and sometimes every week.

The club supports a very well arranged clubhouse with an ample meeting room and library. The dues of active members are $25 a year, while the initiation fee also is $25.

LETTERS TO THE EDITOR

Comment on Matters of Interest
to Engineers and Contractors Will Be Welcome

Professional Engineers and Union Labor

Sir—It is evident that the secretary of the American Association of Engineers has handled without gloves the subject of trade unions in his letter in your issue of Feb. 20, 1919, p. 394. And the public often chastises labor organizations when they hesitate to submit disagreements to arbitration! If his statement that "the outstanding characteristic of union labor is selfishness" can be taken as any criterion of the opinion of the engineers of this country, the solution of the misunderstandings and antagonism between capital and labor is further away more years than I care to count.

Altruism can hardly be said to be the attribute of any particular class, educated or otherwise. Is it fair to put the unqualified brand of "selfish" on union labor? The setting up of class distinction is a step backward. We have just fought a war against political autocracy in order to establish democracy, and the world must progress in this direction. When labor is thus chastised unjustly a tendency to lessen the production costs or increase the output is hardly to be expected. In this connection the words of Shylock come to mind:

> "Fair sir, you spit on me on Wednesday last.
> You spurned me such a day; another time
> You called me dog; and for these courtesies
> I'll lend you thus much moneys."

Ah, no—you can demand a day's work from men, but without justice you better have the paymaster get some cash to pay off the men who want their time. With such an attitude on the part of the engineer there is not likely to be any very close bond of fellowship or mutual understanding between labor and the professional engineer. The attitude of the engineering profession toward labor has been that of aggressive haughtiness and superiority. Labor has had to buck capital for increased wages. In the process the engineer has seen fit to act as go-between. For the most part the engineer has considered capital his client and has tended to show a preference for the point of view of capital in contradistinction to the contentions of labor where disagreements arose concerning working conditions. In the shuffle the remuneration of the engineer has not improved perceptibly.

The first task of the engineering profession is to define what is meant by the term "engineer." Until

such time as this is clearly understood, all argument is futile and it is impossible to arrive at what is a fair wage. You have men calling themselves engineers who can run a level or a transit, but they have no technical education. It is true that a high-school boy can go into an engineering office and in a short time handle a level or transit; a little geometry, trigonometry and logarithms added to his outside work gives him the basic knowledge to handle a considerable variety of work. As a matter of fact, I know any number of bricklayers and carpenters who can handle either a level or a transit and they also have some knowledge of mathematics. The draftsman is closely allied with engineering, but is in the same category as the others mentioned above. Are they engineers? Tell me now, are men of this type qualified to receive as much or more than mechanics? What do you mean when you say "engineer"?

Aside from the technique of the profession, the engineer of the future, to be broadly successful, must be a master of what is called human engineering; he must have a knowledge of men and an appreciation of these conditions, sociological and economic, that have a bearing on the increased production and output of labor. It goes without saying that the cirricula of the colleges must be regulated accordingly.

Springfield, Mass. THOMAS P. MORRISSEY.

Draftsman's and Shoemaker's Salaries

Sir—As another instance of the comparative value of the highly trained technical man and uneducated skilled labor, I quote below advertisements from the official bulletin of examinations published by the State Civil Service Commission of Ohio, for examinations to be held Apr. 9, 1919:

"Architectural Draftsman—the Ohio Board of Administration; Professional and Scientific Service. Architectural group; Grade III. Salary $1500 per annum (fee $1).

"Duties—Incumbent of this position, the duties of which require the exercise of independent judgment, designs items of secondary importance under supervision of architect, develops the more important designs from rough sketches made by the architect, and exercises partial supervision over the work of a tracing clerk.

"Qualifications—(1) Such training as is evidenced by a degree of bachelor of architecture from a technical school of recognized standing, and (2) at least two years of practical experience in architectural work; or (3) at least three years of practical experience in architectural work of similar character will be accepted in lieu of a course in a technical school."

The second advertisement is as follows:

"Shoemaker—Ohio State Reformatory, the Ohio Board of Administration: Skilled Labor Service, Shoemaker Group; Grade I. Salary $1200-$1400 per annum (fee $1).

"Duties—The incumbent of this position, under supervision of the superintendent of shoe shop, assists in supervising inmates employed in the shoe factory; makes patterns for new styles, instructs inmates in the use of various machines, and keeps machines in repair.

"Qualifications—Not less than three years of practical experience in employment affording opportunity to become thoroughly familiar with modern methods and machinery used in manufacture of shoes."

C. H. MCGARRY,
Senior Civil Engineer, Bureau of Valuation, Interstate Commerce Commission.
Chattanooga, Tenn.

Why Not Higher Wages For Other Navy Engineers?

Sir—I have read with interest the letter of William F. Fox, the editor's comment, and the reply of the Secretary of the Navy in regard to readjustment of pay for Navy Department employees, in your issue of Mar. 27, p. 634. The scale of pay for draftsmen may be adjusted to their satisfaction, but for technical employees, who in my opinion are just as valuable as these draftsmen—and more valuable, in some cases—nothing has been done so far as these employees know.

Early in February, or perhaps in January, the Navy Department convened boards at all navy yards to revise the scale for technical employees, and the recommendations of these boards have been in the Secretary's office for weeks, while these employees are struggling along at rates of pay in many cases far below that paid to second-rate mechanics. The former receive the same scales that existed before the war.

The inspectors, to which class the writer belongs, are required to perform difficult and exacting survey work, often in marsh and water, engineering work that pertains to dredging, sea-wall and dock construction, besides supervising millions of dollars' worth of construction, making estimates and valuation, in most instances performing their own clerical work.

Is it fair that this class of trained men, many of whom have spent the best part of their lives in the service of the Government, should be treated this way?

J. M. LUSHBAUGH,
Paris Island, S. C. Inspector, United States Navy.

What Is Correct Interpretation of Overhaul Specification?

Sir—The following overhaul specification has been the subject of considerable contention between the engineer and contractor on a large highway project:

"The free haul on all materials incorporated into the work as a permanent part thereof shall be one mile from the points or locations designated by the engineer, from which such material may be obtained by the contractor for delivery and use upon the work. For each mile or fraction thereof in excess of the said one-mile free haul that the contractor shall be compelled to haul materials to the site at which they are to be used in the work, he shall be paid at the rate per ton-mile bid by him for such overhaul (the short ton of 2000 lb. shall be used). Payment for overhaul as above defined shall be the product of the actual number of tons of material incorporated in the completed structure by its distance in miles and fractions thereof less one mile, of its center of mass from the points of locations, designated by the engineer, as above defined."

Applying this to road-surfacing material, the contractor bids 25c. per ton-mile, and claims payment at that rate for each ton of material incorporated in every mile of work beyond the free haul. The engineer takes

the position that the above clause is merely a technical way of expressing "average haul," and that the contractor is not entitled to 25c. per ton-mile until the material has been actually hauled one mile.

Thus, in the first overhaul mile, for instance, assuming that 100 tons of material are incorporated therein, the contractor asserts there is due him, at the bid price mentioned, the sum of $25, while the engineer asserts that all the material has actually been hauled one-half mile, and the contractor is entitled to payment in the sum of $12.50.

Can readers of *Engineering News-Record* give us a frank interpretation of the above specification?

Forrest City, Ark. R. G. WILLIAMS.

Consistency Test for Concrete Used in Laboratory Practice

Sir—The article by H. A. Davis of the Emergency Fleet Corporation in your issue of Mar. 27, 1919, p. 603, calls attention to a distinct advance in field practice with reference to the control of the consistency of concrete. It may be of interest to note that this method has been in use for several years by a number of testing laboratories. The following quotation is from a set of recommendations prepared under date of November, 1914, by Subcommittee II of Committee C 9 on Concrete of the American Society for Testing Materials, of which the writer is chairman:

> There is no well-recognized standard for the consistency of concrete for use in test specimens. The following method for determining the proper consistency of concrete for laboratory tests will be found to give fairly reliable results: Mix a small batch of concrete sufficient to fill a 6 x 12-in. or 8 x 16-in. cylindrical form. Place in the form in the manner described below. As soon as the specimen is completed, remove the form entirely from the fresh concrete by a steady upward pull. Use care not to disturb the fresh concrete. The correct amount of water has been used when the specimen of fresh concrete shortens about ¼ in. for the 6 x 12-in., and ½ in. for the 8 x 16-in. cylinder upon removing the form.

This set of recommendations was drawn up in conference with Prof. M. O. Withey of the University of Wisconsin for the guidance of testing laboratories which were then coöperating with the committee in carrying out investigations of concrete. Certain revisions were subsequently made in these recommendations by the committee without making any essential change in the method for determining "normal" consistency of concrete.

It is the writer's belief that this method of consistency control was suggested as early as 1912, by Sanford E. Thompson, chairman of Committee C 9.

This "slump" test was described by the writer in the course of a discussion at the Conference on Concrete Road Building held in Chicago, February, 1916. (See *Proceedings*, p. 145.)

In our research work at Lewis Institute we now consider a "slump" of ½ to 1 in. in a 6 x 12-in. cylinder as normal consistency. This gives a more workable concrete than the smaller slump originally recommended, and is more representative of consistencies which can be used in placing concrete. It is found convenient to express other consistencies as percentages of the normal determined by the slump test.

The "slump" test can be made with entire satisfaction by placing a pair of handles or a bail on the metal cylinder form and lifting the form by a steady upward pull with the hands. This is the method contemplated in the original recommendations of Committee C 9.

This test is being incorporated in the revised specification for concrete-road construction by several of the midwestern state highway departments. The requirement is that the concrete shall show a slump of not more than, say, 2 in. for machine-tamped and finished roads, and not more than, say, 5 in. for hand-finished work.

In view of the predominant influence of the quantity of water on the strength and other properties of concrete, the control of the consistency of the mix becomes of prime importance in all work. It is a controlling factor which is generally neglected in tests of concrete carried out in the laboratory with a view to studying the relative merits of different materials, or varying the proportions or methods of concrete making.

D. A. ABRAMS,
Professor in Charge, Structural Materials Research Laboratory, Lewis Institute.
Chicago, Ill.

International Language for Modern Engineers

Sir—I, too, have read with interest the discussion upon "International Language for Modern Engineers," in your issues of Feb. 27, 1919, p. 442 and Mar. 27, 1919, p. 635. Why not adopt English as the international language? It is as expressive as any other and is used by more people than either Esperanto or French.

While French was the diplomatic language of the world, I understand that English has recently supplanted it in a large measure. H. S. MCKIBBEN.
Warren, Ohio.

Peculiar Railroad Section Identified

Sir—The rail section shown on p. 684 of your issue of Apr. 3, 1919, is a relic of about 1860, and is one of the never ending and never successful endeavors to eliminate the low joint and the consequent discomfort to the riders, and the high cost of rolling-stock maintenance.

A considerable amount of this rail was laid by the New York Central R.R. in the neighborhood of Rochester, N. Y., and possibly in other localities. It was not bolted together but riveted, the joint of one side being midway of the length of the other side. The interior ribs were to prevent the webs being drawn in by the riveting. It was smooth-riding, but its life was short.

Haddonfield, N. J. ALONZO G. COLLINS.

High Liability Insurance Rates

Based on total payroll, liability insurance rates in Wisconsin range from 3.9% to 8.95%, depending upon the character of the operation. On bridge construction of no unusual hazard as high as 10% has been charged. The losses in highway construction are very small. It is stated, for example, that on state road work from 1915 to 1917 aggregating several million dollars in cost, the total losses by accident were slightly over $5000. An excessive burden of cost for accident protection, it is considered, is thus being placed upon road construction, and the Wisconsin Highway Commission is to seek relief through legislation, to reduce the cost of liability insurance and surety bonds.

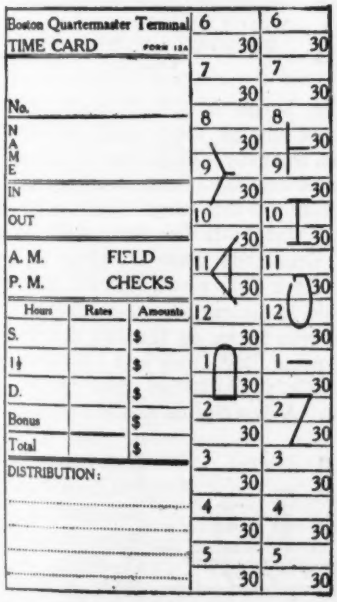
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Time Card As Complete Check On Workmen

COMPLETE daily records of the hundreds of workmen engaged in constructing the $28,000,000 Army supply base at Boston, Mass. (see *Engineering News-Record* of Sept. 19, 1918, p. 522), were kept by time cards. Each card when turned in at night carried records of time when received, time when work started, forenoon at-work check, afternoon at-work check, time when work stopped, and time when returned. By the number of the punch mark it was shown for which foremen the card holder worked and, therefore, the kind of work performed. Cards of six colors were employed, a different color for each working day of the week. The illustration represents the face of one of the cards; on the back are printed in English and Italian brief instructions to the workman.

An exact routine was followed in recording time. After being hired the man was conducted to the Government button booth, where a serial number was assigned to him and a badge was given him. He was then conducted by a messenger to the time booth, where he received a time card and also a brass check bearing the same number as his badge. This brass check was used for getting tools. He was then conducted by the messenger to the foreman to whom he had been assigned.



TIME CARD CHECK FOR LOCATION OF WORKMAN SEVERAL TIMES DAILY
(Original size 3 x 5 in.)

Each morning the workman went to the time booth and received a time card, which was stamped by an electric time stamp, connected with the master clock. After receiving the card he went to the foreman to whom he had been assigned, and the foreman punched the time card at the time of starting work. Each foreman had a numbered punch, and should a man go to another foreman than the one to whom he had been assigned, the error was detected at once. The foreman kept the card until the man stopped work for the day, when he punched the time of stopping work. Should men be shifted to a new foreman or to a different section of the work, the time cards went with them to the new foreman. Each foreman punched the cards when the men left and when getting new men.

A time checker was assigned to a certain number of foremen and was responsible for all field work in connection with the time of these men. Once in the forenoon and once in the afternoon he located each workman by his badge and checked him on a time checker's report. He then went to the foreman and punched the card of each workman he had located. Each time checker had a different lettered punch. Should the foreman have cards of men whom the checker could not find the foreman was required to tell where they were working, and if the time checker found them he returned to the foreman and punched the cards. If he could not, the men received no time. On the afternoon check the time-checker inspected the foreman's reports, saw that every man carried by that foreman appeared on the foreman's report with the proper rate, hours and labor distribution, and, if necessary, he made the report out for the foreman.

When finished working for the day, after the foreman had punched his card, the workman took his time card to the same booth from which he received it in the morning. The card was then put through the time stamp. Time was then computed, and the rate checked against the time checker's report and the foreman's daily report, and if all agreed the time was entered on the time checker's summary sheet. The cards were then turned over to the payroll department and entered on the roll. This timekeeping system was worked out by Maj. Charles R. Gow, constructing quartermaster. The W. F. Kearns Co., Boston, Mass., was the general contractor.

Other Articles in This Issue of Interest to Contractors:

History and Properties of Light-Weight Aggregates — Page 802

Prices Yesterday, Today and Tomorrow — Page 809

Labor Efficiency Good on Percentage Contracts — Page 815

Comparison of Long and Short Highway Contracts — Page 831

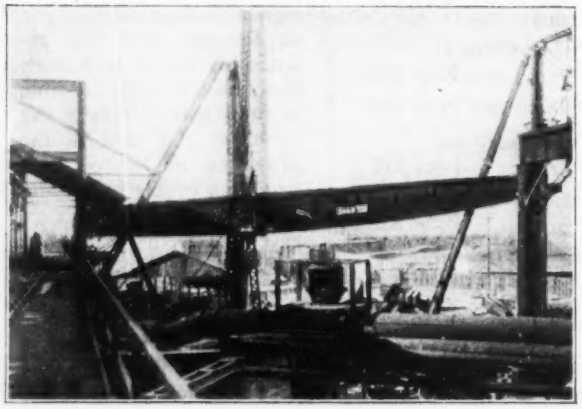
What Is Correct Interpretation of Overhaul Specification? (Letter) — Page 835

Derricks Tilt and Swing Long Girders Between Obstructions

FOUR 94-ft. girders were successfully passed over occupied tracks and threaded through intervening obstacles to a position 53 ft. above the ground in a converter building, by means of a crane and a derrick which repeatedly swung and tilted their load to find a clear way for hoisting. The girders weighed 37 tons each and were for bridge cranes. They had to be hoisted and set with their ends on the crane runways

of the building, which was erected over several tracks on which traffic must continue and over portions of a building which the new building was to replace. A straight hoist was nowhere possible, clearances were small, and sulphur from converters bothered the workmen. The procedure was as follows:

Each girder was received mounted in the usual manner on three flat-cars. When the time arrived for the erection of the girder it was blocked up and balanced on the middle car, and the end cars were switched aside. The girder was then run in through the first bay of the building as far as possible, while the operating tracks were still kept clear. Then a 25-ton locomotive crane, whose boom had been lengthened to 69 ft. by a 20-ft. extension, was headed up to the broadside of the



LOCOMOTIVE CRANE AND DERRICK PLACE BRIDGE CRANE GIRDERS

girder and a hitch taken so as to "telegraph" or swing the girder forward endwise until within reach of a derrick set inside the building. The derrick took a hitch well along the girder, as shown by the view, so as to support about two-thirds of its weight. The crane was then shifted to inside the building and hitched to the extreme end of the girder. Hoisting was then begun. The girder was raised horizontally by the derrick and crane until projecting parts of the old building were encountered, when it was necessary to boom right and left three times to clear the obstacles. Finally, to pass the 94-ft. girder between the runways, which were only 90 ft. apart, the derrick-supported end had to be tilted sharply upward. Good speed was made. In eight hours two girders were placed and a third girder was made ready for moving into the building.

The work was done for the Consolidated Kansas City Smelting and Refining Co. by the El Paso Bridge and Iron Co., El Paso, Tex., Henry E. Robertson, engineer of construction, acting as superintendent.

Blasting Mats Under Building Foundations

IN BUILDING the section of the Broad St. subway under the Philadelphia City Hall, one step in the work requires the use of temporary concrete mats which serve as mud sills for one end of needle beams. When the underpinning is completed, so that the needling may be removed, the first step after removal of the earth is to take out these mats. For a time they were removed with cold chisels and air hammers, but progress was so slow that the practice was adopted of putting in a half stick of dynamite and blowing them down. It is found that the effect of the charge extends a good deal beyond its immediate location, serving to loosen the mat over a large area, so that with slight hammering it can then be brought down with ease.

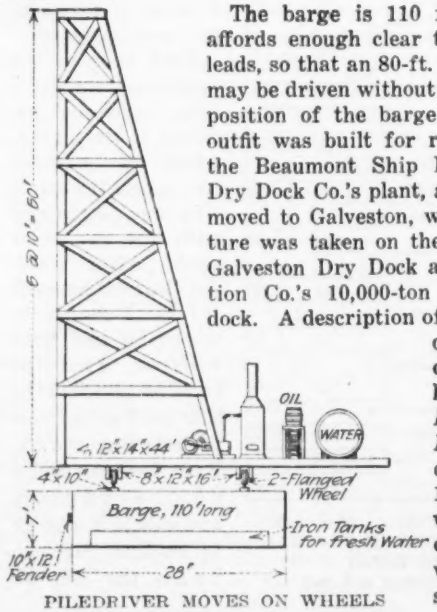
Part of the equipment for breaking up the mat after the charge has been fired is an air-driven cutting hammer, the barrel of which is so long that it can reach deep into confined spaces. It is a single-stroke machine, made by the Rivet Cutting Gun Co., of Cinncinati, Ohio.

The work at the Philadelphia City Hall is being done by the Keystone State Construction Co., with which is associated the Underpinning and Foundation Co., of New York City.

Wheels on Driver Save Many Moves of the Driver Barge

MAXIMUM speed in moving from pile to pile is gained in Capt. John Jacobson's driver-barge outfit by mounting the leads on a truck and placing the truck on a track which runs the length of the barge. A 9 x 10-in. two-drum double engine mounted on the truck is used as piledriver engine, as well as for the movement of the leads and of the barge. The boiler is also mounted on the truck. It burns fuel oil. According to Captain Jacobson, ample steam is produced with a single burner. A barrel behind the boiler and a tank at one end of the barge hold the fuel-oil supply. Steel tanks for a 10-day supply of fresh water for steam production are placed below the barge floor.

LEADS, ENGINE AND BOILER MOUNTED ON MOVEABLE TRUCK



PILEDRIVER MOVES ON WHEELS

The barge is 110 ft. long, and affords enough clear track for the leads, so that an 80-ft. row of piling may be driven without changing the position of the barge itself. The outfit was built for rush work on the Beaumont Ship Building and Dry Dock Co.'s plant, and was later moved to Galveston, where the picture was taken on the slip for the Galveston Dry Dock and Construction Co.'s 10,000-ton floating dry dock. A description of the building of this dry dock was published in *Engineering News-Record* of Mar. 20, 1919, p. 552, where many other details were described.

NEWS OF THE WEEK

New York, April 24, 1919

Predicts European Demand for Young Engineers

According to a letter recently received by A. D. Creer, consulting engineer of Vancouver, B. C., from a young engineer who had consulted the secretary of the Institution of Civil Engineers, Dr. J. H. T. Tudsbery, the latter is advising young men that within a year there will be a greater demand in Europe for engineers than ever before. This advice is considered significant, in view of Dr. Tudsbery's reputation for conservative statement.

No Labor Union for Roadmasters

The Roadmasters' and Maintenance of Way Association of America has issued a notice to railway maintenance engineers, roadmasters and supervisors of track, denying certain rumors that the association had affiliated with a labor union. The statement quotes a resolution adopted by the executive committee last November to the effect that the association cannot be identified with any labor organization without departing from the purposes for which it has stood for 36 years, and which are set forth in the charter of the association as follows: To meet and discuss matters pertaining to track and to raise the standard of work committed to the charge of its members.

Reconstruction Information Available

The United States Council of National Defense has announced that it has a great quantity of material on hand relating to the various problems which come under the general head of reconstruction, and that it will be glad to coöperate with business men who have problems along this line to solve. The reconstruction and research division of the council, 18th and D Sts., Washington, D. C., should be addressed for information.

Self-Propelled Steel Canal Barges To Be Built

The Division of Inland Waterways, United States Railroad Administration, has just let contracts for the construction of 20 self-propelled steel cargo barges for the New York State Barge Canal. Twelve of these barges are to be built by Terry & Tench, of New York City, at a price of $87,000 each. Four barges will be built by the Dravo Contracting Co., of Pittsburgh, at $87,000 each, and four by Starr & Bennett, of Newbern, N. C., at $83,500 each. The barges will carry 450 tons of cargo and will be capable of towing three 600-ton barges besides.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

The Federal director of the United States Employment Service in New York State announces the receipt of a letter from J. P. Morgan & Co., in which $100,000 is offered for the purpose of continuing the work of the service up to July 1 of this year. The Professional and Special Section in New York will therefore be continued, but will be located at the main office, 469 Fifth Ave., New York City.

Bids in for Cantonments

Bids submitted by various firms for the 13 Army cantonments offered for sale, as mentioned in *Engineering News-Record* of Mar. 27, 1919, p. 639, have been received by the War Department. The bids, in tabulated form, are given on p. 235 of the Construction News section of this issue.

W. B. Parsons Returning With Engineer Unit

Cable advices have been received from Col. William Barclay Parsons, Engineers, U. S. A., that Companies B and C, seven officers and 266 men, including Lieutenant Colonel Hudson, sailed for this country on the "Santa Theresa," and that the remaining companies, 49 officers and 696 men (including Colonel Parsons) sailed Apr. 15 on the transport "Chicago."

Iowa Water-Works Men Hold Spring Meeting

Depleted Well Supplies, Pollution of Them, Iron Removal, Hardness Limits, Uppermost Topics

Postponed from 1918 on account of the war, the annual meeting of the Iowa Section of the American Water-Works Association was held Apr. 16-17 in Iowa City. So interested in the state problems were the thirty participants that they intend to meet again in October. Serious shortages and growing pollution of the well supply, forcing cities to surface sources, problems arising from extreme hardness and iron, treatment, distribution, costs and the financial outlook, all taken up from the local standpoint, gave ample evidence of the value of the formation of the section.

As heavier drafts have been made on many well supplies of the cities of the state the ground water has receded to an alarming extent. This is particularly true in the southwestern section. Lafayette Higgins' paper on "Future Public Supplies" gave valuable information on this point, on the excessive cost of deep-well pumping and treatment—that is, if treatment can be effected at all. Many supplies have a mineral content, near or about 1100 ppm., which he considered the upper limit beyond which it is unfit for use even after treatment. He divided the state into three general areas. In the inland portion, drill or tubular wells are the only possible future source. Cities located on the streams must eventually use them, for few of the valleys contain gravel beds sufficiently free from silt to collect the water by wells or galleries. Impounded water will be the only logical course for many cities, and luckily they are located in that area of the state having the greatest rainfall and at least a 50% run-off.

Discussing pollution, Miss Zelma Zentmire, water analyst for the State Board of Health, indicated that for the 18-month period beginning July, 1917, more than 50% of the public shallow wells examined are unsafe and that only 75% of deep wells are acceptable. Of the private wells 75% of the shallow wells examined are bad, as are 33% of the deep wells. On the other hand 95% of the treated supplies examined are good.

An iron-removal plant at the Iowa State College consisting of a dripping aërator, sedimentation and rapid filter reduces the iron content from shallow wells in a creek bed from 8 to 0.07

(*Concluded on page* 842)

Greater Winnipeg Water-Supply in Service

Concrete Aqueduct 96.3 Miles Long Will Carry Soft Water to District of 92 Square Miles Area

Despite the war, the new gravity water-supply for the Winnipeg Water District, work on which was begun in 1913, became available between Mar. 28 and Apr. 5. It was doubly welcome, writes W. G. Chace, chief engineer of the district, because the previous artesian supply, obtained by pumping, had a hardness of nearly 500 ppm., compared with about 40 for the new supply. The source is Indian Bay, on Shoal Lake, an arm of the Lake of the Woods. Except for a few Indians, the drainage area is uninhabited.

The aqueduct is 96.3 miles long and has a total fall of 294 ft. For the easterly or upper 84.62 miles it has a daily capacity of 120,000,000 U. S. gal. At this point there will ultimately be built a reservoir with a capacity of 300,000,000 U. S. gal. From here 11.7 miles of pressure conduit, with a daily capacity of 75,000,000 U. S. gal., have been built and will be duplicated in the future.

Of the entire length of aqueduct, 77.5 miles are of open-flow section and 18.8 miles are of reinforced-concrete under pressure, with heads up to 90 ft. Beneath the Red River there is a tunnel 1800 ft. long, lined with 60-in. cast-iron pipe.

The Greater Winnipeg Water District includes the Cities of Winnipeg and St. Boniface, the town of Transcona and parts of St. Vital, Fort Garry, Assiniboia, East and West Kildonan, and has an area of about 92 square miles. The water debt is a lien on the works and the lands in the district. The capital charges are paid by taxes on the lands alone. Operating and maintenance charges are to be met by the municipalities supplied.

The water-supply project was based on a report made by Rudolph Hering, Frederic P. Stearns and James H. Fuertes. The latter has been consulting engineer for the district throughout. W. G. Chace is chief engineer. M. V. Sauer was originally chief of design. He was succeeded by James Hyslop.

Most of the work was done by local contractors. The largest contract, for the easterly 47.4 miles, was held by the Winnipeg Aqueduct Co., composed of Messrs. Carter, Halls and Aldinger, and the Northern Construction Co., and having William Smail as superintendent. This contractor, jointly with the Canada Lock Joint Co., also built 9.3 miles of 5½-ft. reinforced-concrete pipe. J. C. Mitchell was superintendent of the pipe company.

For a British Ministry of Health

Provision is made for a British Ministry of Health in a bill now before Parliament. It would include the present Local Government Board, with a new name and additional powers. Later some of the powers of the ministry would be transferred, including such matters as public libraries, the regulation of whistles, heavy locomotives and motor cars on highways, old-age pensions, and local elections.

Americanization Conference Program

The program for the conference of Americanization specialists and workers to be held in Washington, May 12-15, inclusive, under the auspices of the Interior Department, has been divided into four sections, each day having a special topic, as announced by the Americanization division of the Bureau of Education. Monday will be educational day, Tuesday will be given over to a consideration of Americanization in the industries, Wednesday to addresses on racial relationships and Thursday to the social aspects of the Americanization movement. Franklin K. Lane, secretary of the interior, will speak at a banquet to be held Wednesday evening.

War Material Is Available for Highway Work

The Bureau of Public Roads of the Department of Agriculture has received from the War Department an inventory of available tractors and a tentative inventory of trucks, as the first step in carrying out the law, enacted at the last session of Congress, authorizing the Secretary of War "to transfer to the Secretary of Agriculture all available war material, equipment and supplies not needed for the purposes of the War Department, but suitable for use in the improvement of highways." There is every indication that the War Department will coöperate with the Department of Agriculture in the disposal of surplus stocks, and it is expected that inventories of all materials will be completed within the next two weeks and submitted to the Secretary of Agriculture, so that he may decide what use to make of them in the construction of highways.

Some of the materials and equipment which could be used to advantage in road building has been enumerated as follows:

Machine Tools, Engineering and Construction Equipment — All metal and wood-working tools; steam shovels; hand tools; forging equipment; iron and structural workers' power tools and machinery; contractors' equipment, such as dredges, ditchers, concrete mixers; industrial railways, etc.

Trucks and Motor Equipment— Trucks; trailers; animal- and hand-drawn vehicles; passenger automobiles.

General Supplies—Tentage, paulins, harness, saddlery, saddlers' supplies; shelf and heavy hardware; tools, handles, tool chests, containers; mess, camp and kitchen equipment; hemp and jute products; brooms and brushes.

Remount—Horses and mules.

Raw and Scrap Materials — Explosives.

Ordnance and Ordnance Stores— Tractors and trailers, caterpillars.

New York State Highway Department Is Reorganized

Under the new highway commissioner, Frederick Stuart Greene, whose appointment was noted in *Engineering News-Record* of Apr. 17, 1919, p. 792, the main office force of the New York State Highway Department has been reorganized. The following changes have been made in personnel:

As first deputy commissioner, Paul Schultze, of Albany, succeeds H. Eltinge Breed, resigned; as second deputy commissioner, Irving V. A. Huie, of New York City, succeeds F. W. Sarr, resigned; as third deputy commissioner, Charles Van Amburgh, of Broome County, succeeds Benjamin Rice, resigned, and as secretary of the commission, Royal K. Fuller succeeds Irving J. Morris, resigned.

Mr. Schultze, the new first deputy, has had extensive experience in highway construction. He was second deputy commissioner from 1913 to 1915. Upon graduation from the Rensselaer Polytechnic Institute in 1891, he entered the New York State Engineer's department as assistant engineer in charge of bridges and roads, remaining until 1900. From 1900 to 1908 he was city engineer and superintendent of public works in the City of Utica, N. Y.; from 1908 to 1912, county superintendent of highways of Oneida County; from 1912 to 1913, city engineer of Troy, N. Y. Since 1915 he has been a consulting highway engineer and contractor in Albany, N. Y., and during the war was superintendent of roads at the Jacksonville Powder Works in Tennessee, and built the roads at the du Pont Powder Works at Carney's Point and Deepwater, N. J. As first deputy he will have charge of all new highway construction work of the department.

Mr. Huie, who will be second deputy in charge of maintenance, is a graduate in civil engineering at New York University, 1911. Upon graduation he entered the office of F. A. Molitor, consulting engineer, New York City, where he remained until 1916, becoming principal assistant engineer to Mr. Molitor on railway location and valuation work, both in this country and Brazil. Early in the war he was commissioned first lieutenant in Company B of the 1st Regiment of Engineers, and during the war he was advanced to the rank of major of engineers.

Mr. Van Amburgh, the third deputy, who will have supervision of all work on town highways, has been county engineer of Broome County. The new secretary, Mr. Fuller, has served several terms as secretary.

Ontario Highways Act Passed

The Ontario legislature has passed the highways act introduced by the Government, appropriating $5,000,000 for highway construction and maintenance. The Hon. F. G. MacDiarmid, minister of public works, stated that the Government highway program includes the building of a provincial highway

from Toronto to Windsor, of which probably 200 miles will be of concrete, 175 miles of macadam, and the remainder of gravel. The work will take several years. In addition, the appropriation includes about $1,800,000, to be paid to the counties for the improvement of county road systems. There are 37 counties under this scheme, the average expenditure of each being $100,000 annually. The province will provide 40% of this outlay.

Recommend Large Pier at Portland, Me.

In the report of the State Harbor Commission of the State of Maine for the calendar year 1918, there is a report prepared by the firm of Fay, Spofford & Thorndike, of Boston, on the advisability of building a public pier at Portland, Me. As a result of the investigation the commission recommends to the legislature that the state construct a pier in tidewater at Portland at the site selected and recommended by the engineers, the pier, freight sheds and railroad connections to be built, controlled and operated by a harbor board, which should be appointed by the Governor and council.

Furthermore, it recommends that the state legislature authorize the issue of $1,150,000 bonds to take care of the improvements. The engineers' report points out the strategical position of Portland as a port and the present lack of modern pier facilities there. The engineers do not specify the pier design in detail, but indicate enough of its general construction to show what the layout will be. It is expected that the legislature will provide for the structure.

Dwelling-House Plans of Housing Corporation Available

Plans for dwellings, prepared by the United States Housing Corporation for building homes in congested industrial centers during the war, are to be made available for general public use. The Department of Labor announced that types of homes would be given to "own-your-own-home" committees, promoting building activities in cities.

In the department's effort to expand the home-ownership campaign, letters were sent to municipal officials, labor leaders and club organizations in many cities, urging local campaigns.

Working Conditions Service

To assist industrial establishments in securing and maintaining the health, safety and good government of their workers, the United States Department of Labor has formed a Working Conditions Service, in three divisions: (1) Industrial hygiene and medicine, with personnel detailed from the United States Public Health Service; (2) labor administration; (3) safety engineering. Details are given in a pamphlet obtainable from Grant Hamilton, director general of the United States Department of Labor, Working Conditions Service, Washington, D. C.

British Government Plans Department of Transportation

The British Government has for some time been planning to establish a separate Government department to deal with all matters of transportation, and a bill for that purpose is now pending in Parliament. The new department is to be called the Ministry of Ways and Communications and is to take over the powers of supervision over railways and other transportation utilities, which have long been exercised by the Board of Trade. So long as the railways continue under direct Government management, as has been the case since Great Britain entered the war, this authority also is vested in the Minister of Ways and Communications. Besides the railways, the minister receives authority over the street railways, canals and other inland waterways, docks, piers, roads, bridges, ferries and the supply of electricity. The bill empowers the minister to fix all rates and charges and the wages of labor on all utilities under his charge. While there has been no official decision as to whether the Government will take over permanently the railway lines of the country, the bill in Parliament gives the minister authority to purchase any utility under his charge outright at a price fixed by agreement or by condemnation proceedings.

Great economies have been effected in the operation of British railways since the establishment of Government control, through the consolidation of facilities and the cutting down of train service. Notwithstanding these economies, the increases in wages to railway employees have so increased the operating expenses that the estimates submitted to Parliament indicate a probable deficit of some $300,000,000 on this year's operations.

It is said that the first head of the new Government department will be Sir Eric Geddes. Sir Eric spent his early business life in the United States, where he was engaged in the lumber business in the South. Later he was connected with the Baltimore & Ohio R.R. and then became manager of the Northeastern Ry. of England, and in 1916-17 was director general of military railways and inspector general of transportation.

Iowa Engineers Must Register

Engineers and land surveyors in Iowa must be examined and registered by a State Board of Engineering Examiners, according to a bill which has passed both houses of the General Assembly. The bill provides for the appointment by the Governor of an examining board of five members, who will conduct examinations and issue certificates to persons qualified to practice professional engineering or land surveying. The expenses of this board are to be paid from the examination and registration fees. Severe penalties are provided for illegal practice, and the board has authority to revoke a certificate for fraud or incompetency. All plans, specifications and reports must be stamped with the official seal of a registered engineer

Engineers and surveyors who have practiced for two years or more in Iowa may be registered without examination at any time within six months after the act takes effect. The act does not apply to full-time employees of a corporation doing work solely for that corporation; or to existing contracts; or to United States Government employees; or to assistants to registered engineers and surveyors; or to the operation of mechanical plants; or to the construction of works of a strictly private nature, such as farm drainage; or to the subdivision of land where no controversy is involved.

Pearl Harbor Dry Dock Finally Completed

The United States naval dry dock at Pearl Harbor, near Honolulu, was unwatered for the first time Apr. 11, and found free from leaks. It is expected that the dock will be ready for service by July 1. It is designed for the largest vessels, being 1040 ft. long by 148 ft. wide.

The first attempt to build this dry dock failed and the plans were abandoned, as a result of foundation failure that occurred as the site was being unwatered for the first time. Under the revised plans, according to which the dock has been built, the concrete structure was cast in 16 sections, which were floated to place, as described in *Engineering News-Record* of July 25, 1918, p. 173.

Weights and Measures Convention

A conference of weights and measures officials is to be held at the Bureau of Standards, Washington, May 21-24. The last such conference occurred in 1916, and many questions are pending which the coming conference is to consider. In the 14 years since the movement was initiated, much progress has been made in bringing about uniformity in state legislation concerning weights and measures, and in improving the methods of inspection. S. W. Stratton, director of the Bureau of Standards, is president of the annual conference, and L. A. Fischer of the bureau is secretary.

Plan Reunion of "Eighty-Niners"

Plans have been made for a reunion dinner to be held in New York City about May 27, at which it is hoped that all the survivors of a party of American engineers, belonging to the four national engineering societies, who sailed for Europe 30 years ago to visit England and the Paris Exposition of 1889, may be present, with members of their families.

It is requested that anyone who was of that party communicate with the secretary of the committee, Jesse M. Smith, Engineers' Club, 32 W. 40th St., New York City.

Iowa Water-Works Association Holds Spring Meeting

(*Concluded from page* 839)

ppm. C. S. Nichols described the installation and operating experiences, indicating that no difficulties with crenothrix had arisen and that the operating cost was $6.10 per million gallons.

The latest improvements to the Des Moines galleries in the way of an irrigation and ponding system were described by A. T. Luce, the newly appointed chief engineer of the Des Moines Water Company.

An example of the high cost of deep-well pumping was given in detail for Grinnell by Dean W. G. Raymond, a member of the State Board of Conciliation, to which the Iowa Light, Heat and Power Co. has appealed for adjudication of the water-pumping costs to which the city objected as being too high. The charge was 22c. per 1000 gal. and 15.2c. was found, on expert examination, to be the actual total cost with all interest and depreciation percentages added. Settlement was made on this basis.

Waterloo Kept Water-Main Construction Costs Low

Water-main construction costs in Waterloo for the past four years were given by W. A. Judd, the 1918 pipe-laying figure being kept consistently low by retaining the former dependable emergency gang.

C. R. Henderson, manager of the Davenport Water Co., is opposed to laying mains in alleys. His paper on the subject was in effect an argument by which he converted the city officials to his viewpoint. No room, impaired service due to alleys not being continuous, and none at all in one direction, were his chief points.

Thomas Healey, also of the Davenport Water Co., described experiences, all favorable, with metalium as a substitute for lead as a pipe-jointing material. Other uses, such as packing behind bands on cracked pipe and as a substitute for grouting under engine foundations, were noted by H. V. Knouse, of the Metropolitan Water District, Omaha.

He also described the monolithic reinforced-concrete lining of several reservoirs in Omaha since 1914. The fact that every operation in the construction was carried on with labor under direct control of the designer seemed to be a large factor in the success with which the work was prosecuted. The service has been entirely up to the expectations of the designers.

Advocates Formula for Loss of Head in Clean Pipes

S. L. Etnyre, superintendent of the Council Bluffs water-works, is of the opinion that the parent association should adopt a single basic formula for the loss of head in clean pipes. In his paper were noted experiments on long stretches of new pipe 6, 8, 10 and 16 in. in diameter. Only one of the 10 formulas generally available checked with his results.

The officers elected for 1919 are as follows: Chairman, W. A. Judd; vice-chairman, G. E. Shoemaker; directors, H. V. Knouse and W. A. Hostetler. J. H. Dunlap is the acting secretary during the absence of Lieut. J. J. Hinman in France.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, $1200-$1440 per year, May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District, $1501 to $2100 per year. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

Philippines.—Wireless engineer, Bureau of Posts, Philippine Government, $3000 per year, June 10. Apply for form B. I. A. 2, to be filed before June 10, filled in by medical officer in the service of the United States.

Tennessee.—Assistant highway engineer, $1800 to $2100 per year, May 7, at Nashville. File applications as soon as possible.

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States.—Expert patent investigator, $1800 to $2400 per year, and technical patent expert, $2400 to $3600 per year, May 20.

United States.—Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

United States.—Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

United States.—Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

United States.—Scientific assistant in public health work, Public Health Service, $1500-$2500 per year, June 3. Apply for form 2118, to be filed before June 3.

United States.—Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File applications before June 10.

United States.—Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

United States.—Junior recreational engineer, Forest Service, Denver, Colo. $1800 to $2400 per year, May 6. Apply for Form 2118.

United States.—Statistician, Department of Interior, $1800 per year, May 13. Apply for Form 2118.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

The Engineering Society of Western Massachusetts was formed at a meeting held in Springfield Apr. 16. The meeting was addressed by William Spencer Murray, consulting engineer, New York City, Dr. George Otis Smith, director of the United States Geological Survey, and Prof. L. P. Brackenridge, of Yale University.

The Cincinnati Chapter of the American Association of Engineers recently elected the following officers: President, E. K. Ruth; vice-president, G. E. Halstead; secretary, L. P. Kimball; treasurer, Charles S. Carroll. The matter of proposed license laws for engineers was discussed, and a committee was appointed to make a report at the next meeting, to be held Apr. 30. The chapter will be formally installed May. 24.

The Southern California Association of Members of the American Society of Civil Engineers was addressed by Robert A. Cummings, consulting engineer of Pittsburgh, and member of the Committee on Development, at a meeting held Apr. 9. Frederick C. Noble, consulting engineer, New York City, also a member of the Committee on Devel-

opment, spoke on the work of the committee. The meeting was also addressed by Dr. Ford A. Carpenter, United States meteorologist, who spoke on "Precipitation in Southern California," and by F. C. Ebert, hydrographer, United States Geological Survey, on "Flood Run-Off." The committee on reconstruction and development presented its report to the meeting.

The Portland (Ore.) Chapter of the American Association of Engineers, in process of formation, has elected the following officers: W. H. Marsh, president; R. W. Barnes, principal assistant engineer, Southern Pacific Co., secretary-treasurer.

The Engineers' and Architects' Club of Louisville, Ky., held a meeting Apr. 15, which was addressed by Alfred Pirtle, who spoke on "Railroad Reminiscences," including a review of the history of local railroads, beginning in 1843. Several reels of motion pictures, furnished to the club by the War Department, illustrating engineering work in the Army, were shown.

The Scranton (Penn.) Engineers' Club held a meeting Apr. 17, at which Maj. L. S. Doten, U. S. A., spoke on sewage-disposal plants in the United States Army cantonments.

The Topeka (Kans.) Engineers' Club made a trip of inspection to the city water-works, Apr. 5, as the guests of Wilbur Stanfield, newly elected water commissioner, and Jesse Shaw, superintendent of the plant.

The Albany Society of Civil Engineers was addressed Apr. 22 by J. Loewenstein, assistant engineer, American Bridge Co., who read a paper, illustrated with motion pictures and lantern slides, on "The Hell Gate Bridge."

The Louisiana Engineering Society was addressed Apr. 14 by Maj. W. B. Gregory, U. S. A., on "Pumping Machinery Used by the American Army in France."

PERSONAL NOTES

MAJ. MAX C. TYLER, Corps of Engineers, U. S. A., has been assigned to duty in charge of the District of Columbia water-supply system, the reclamation of the Anacostia River and the improvement of the Potomac River, succeeding Col. W. L. Fisk, U. S. A., retired. Major Tyler had been in command of the 212th Engineers, which was reorganized at Camp Devens, Massachusetts, with the rank of colonel for the period of the war.

LIEUT. THORNDIKE SAVILLE, U. S. A., who was stationed at Langley Field, Hampton, Va., in charge of the installation of the water-works and sewage-disposal plants, has received his discharge from the service and has become associate professor of sanitary engineering, University of North Carolina.

LIEUT. PATRICK J. SLATTERY, Air Service, American Expeditionary Forces, has just received his discharge from the service and has become associated with RAYMOND J. VAN WAGNER and ANTHONY J. DAINO, both formerly assistant engineers on subway construction, New York City, under the firm name of the Slattery Engineering & Construction Co., Inc., engineers and contractors E. 42nd St., New York City.

H. A. DIXON, division engineer, Canadian Northern Railway System, Vancouver, B. C., has been appointed chief engineer, Canadian National Railway System, Western Lines, succeeding Allen T. Fraser, whose death was noted in *Engineering News-Record* of Apr. 10, 1919, p. 747.

LOUIS JALOVEC, electrical engineer and designer of X-ray apparatus, Chicago, has been appointed assistant to the United States Foreign Trade Commissioner to Czechoslovakia. He will be stationed in Prague, Bohemia, and will furnish particularly information in regard to markets, although inquiries for data of any kind about the country will receive attention.

CAPT. ROLAND TONER, Construction Division, U. S. A., who recently received his discharge from the service, has been placed in charge of the construction of buildings in Eastern Canada for the Allen Theatre Enterprises of Toronto, Ont.

ROSS J. BUCK, contracting engineer, has been appointed assistant engineer for the Board of Sanitary Commissioners, Indianapolis Sanitary District. From 1907 to 1914 Mr. Buck served in Government engineering work in the Philippines, and after his return to this country entered the general contracting business.

WILLIAM E. PETTY, who was chief draftsman for Division No. 3, New York State Highway Department, until he entered the Federal Government service several months ago to build the roads in Camp Eustis, Virginia, has been appointed confidential agent for the highway department, with office at Albany, N. Y.

CAPT. E. J. BURKE, Engineers, U. S. A., and, after his discharge examiner for the United States Employment Service, has been selected as manager of the Chicago Chapter of the American Association of Engineers. After leaving the University of Illinois in 1913 he was assistant engineer on track-elevation work for the Chicago, Rock Island & Pacific Ry., and later was employed on drainage work in Tennessee.

CAPT. B. C. BRENNAN, U. S. A., who recently received his discharge from the service, has resumed his position as city engineer of Kenosha, Wis., succeeding P. J. HURTGEN, who acted as city engineer in his absence, and who now becomes commissioner of public works.

SIDNEY B. BOWNE has received his discharge as assistant sanitary engineer, United States Public Health Service, and has resumed his position as secretary-treasurer of the W. E. Sexton Co., Inc., engineering contractors, Mineola, N. Y. He has been appointed village engineer of Mineola for the coming year.

LEWIS R. ASH, whose resignation as city manager of Wichita, Kans., was noted in *Engineering News-Record* of Apr. 3, 1919, p. 693, has again been retained as city manager of Wichita. He is a member of the firm of Harrington, Howard & Ash, consulting engineers, Kansas City. For several years he was city engineer of Kansas City.

CAPT. FRANK L. BOLTON, Engineers, U. S. A., has received his discharge from the service and has returned to the firm of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn., as resident engineer in charge of the Mill Creek flood-control project, as well as the work of the firm in western New York, western Pennsylvania and Ohio.

P. F. STARY, highway engineer, Pine County, Minnesota, has resigned to become county highway engineer at Fargo, N. D., succeeding Eric Martinson, who resigned to engage in highway contracting.

MAJ. WALTER B. ELCOCK, U. S. A., has received his discharge from the service and has returned to his former work as district engineer in charge of the Atlanta, Ga., office of the Portland Cement Association.

JOHN A. WALLACE, who has been associated with the New York State Highway Department since 1907, and was recently stationed at Jamestown, has been appointed highway engineer for the Federal Bureau of Public Roads, with headquarters at Montgomery, Ala.

CAPT. HOWARD H. GEORGE, Engineers, American Expeditionary Forces, who recently returned from France and received his discharge from the service, has resumed his former work as assistant engineer, Public Service Railway Co., Newark, N. J. Captain George served as engineer-officer

in charge of building construction of the storage depot at Montierchaume and was afterward transferred for duty with the base section engineer at Havre.

CAPT. T. E. SEELYE, of the firm of Gannett, Seelye & Fleming, who has been oversees with the 105th Engineers, has been assigned for special duty in France as instructor in advanced hydraulics at the American University, France.

CAPT. W. WATTERS PAGON, Construction Division, U. S. A., who recently received his discharge from the service, has opened offices as a consulting engineer in the Lexington Building, Baltimore.

LOUIS J. SNYDER and J. L. LANGTHORN have become associated under the firm name of the Langthorn Co., Inc., to conduct a general engineering and contracting business, with offices at 2 W. 45th St., New York City.

S. H. LEA, who formerly was engaged in construction work for the Government at the Langley Aviation Field, has been appointed road engineer for Mineral County, West Virginia, with headquarters at Keyser.

ALLEN H. STUBBS, formerly of the civil engineering department of the University of Nebraska, has been appointed manager of the Kansas City office of Hedrick & Hedrick, bridge engineers.

J. C. ALLISON and PAUL M. ENTENMANN have become associated under the firm name of Allison & Entenmann, consulting engineers, with offices in Los Angeles and Calexico, Calif.

ROY THOMAS, previously engineer of Gila County, Arizona, has been appointed city engineer of Miami, Ariz., and will have special charge of flood-control work which has just been undertaken.

W. HOWARD CORDDRY, who recently returned from overseas, has received his discharge from the service and has returned to his work with the firm of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn.

VIRGIL P. KNOTT, associate professor of civil engineering, Arkansas State University, has been elected state highway engineer, succeeding Hugh Carter, resigned.

CAPT. D. A. TOMLINSON, instructor in the Coast Artillery at Fort Monroe before his discharge from the Army, has been made assistant secretary of the American Association of Engineers. He has charge of the railroad work, and will aid in the service clearing house department. He was until recently manager of the central zone of the United States Employment Service. Captain Tomlinson saw service on the Mexican border in 1916, previous to that having been valuation engineer on the Chicago & Western Indiana Railroad.

ALAN CORSON has been appointed superintendent of Fairmount Park, Philadelphia, succeeding Jesse T. Vogdes, whose death was noted in *Engineering News-Record* of Mar. 27, 1919, p. 644.

ROGER W. HARMAN, 204th Engineers, U. S. A., who recently received his discharge from the service, has returned to his former position with Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn.

HALE D. JUDSON has resigned as city engineer of St. Joseph, Mo., to enter the State Highway Engineering Department.

H. MARCUS, who served with the Bureau of Yards and Docks during the war, has returned to his duties with the Marcus Contracting Co., New York City.

R. W. WATERMAN, hydraulic and irrigation engineer of Los Angeles and Blythe, Calif., has removed to Fresno.

F. A. TROSKEL has been appointed city engineer of Marquette, Mich.

OBITUARY

JOHN T. DICKERSON, general manager of the Strauss Bascule Bridge Co., Chicago, died in that city Apr. 14. He was born in 1878 and was a graduate in civil engineering of Rose Polytechnic Institute in the class of 1902. For the past seven years he was identified with the Strauss Bascule Bridge Co. Prior to that time he was assistant engineer and general sales engineer with the Scherzer Rolling Lift Bridge Co., of Chicago, and before that he was in the bridge departments of the Chicago, Burlington & Quincy and the Chicago, Rock Island & Pacific R.R. companies and the American Bridge Company.

CHARLES BRINKERHOFF RICHARDS, scientist and inventor of the Richards steam engine indicator, and for 25 years Higgins professor of mechanical engineering at Yale, died in New Haven, Apr. 20, in his 86th year. During the Civil War he was consulting engineer and assistant superintendent at the Colt's Arms factory at Hartford. Later he served as superintendent of the Southward Foundry & Machine Co., of Philadelphia, before he was called to the Sheffield Scientific School. In recognition of his invention of the steam engine indicator, he was decorated with the Legion of Honor of France. He was consulting engineer for the state capitol at Hartford and other large buildings.

GEORGE FERDINAND BECKER, geologist and mining engineer, who had been connected with the United States Geological Survey since 1879, died in Washington, D. C., Apr. 20, at the age of 72. He was a graduate of Harvard University, received the degree of doctor of philosophy from Heidelberg University, and in 1871 was graduated from the Royal School of Mines in Berlin. For four years he served as instructor in mining and metallurgy in the University of California, from which he went to the United States Geological Survey. At the time of the Spanish-American War Dr. Becker was detailed to serve as geologist on the staff of General Bell with the Army in the Philippines.

CHARLES E. CHENEY, former county surveyor of Marion County, Indiana, died in Indianapolis Apr. 14. He was 45 years old. He was a graduate of Purdue University in the class of 1897, and soon after his graduation was appointed city engineer of Frankfort, Ind.

J. A. STAMPS, chief engineer of the Atlanta water-works, died in that city Apr. 5. He had been connected with the water-works department for 36 years.

JOSEPH E. JOHNSON, JR., consulting engineer, New York City, whose death on Apr. 4, 1919, was noted in *Engineering News-Record* of Apr. 10, 1919, p. 747, was born in 1870 and was graduated from Haverford College in 1888, receiving the degree of mechanical engineer in 1891. He entered engineering work as a draftsman in the Baldwin locomotive works, Philadelphia, and was afterwards engaged with the Straight Line Engine Co. and the Cranberry Iron & Steel Co. He later entered the service of the Carnegie Steel Co., in the blast-furnace department, and afterward became general manager of the Princess Furnace Co. In 1909 and 1910 he was general superintendent for the Republic Iron & Steel Co., operating three blast furnaces and 900 coke ovens. From 1901 to 1913 he was manager of the Ashland plant of the Lake Superior Iron & Chemical Co., Ashland, Wis. In 1913 he opened an office as a consulting engineer in New York City to engage in private practice. Besides being a generous contributor to the technical press, he was the author of treatises on "Blast-Furnace Construction in America," followed by "The Principles, Operation and Products of the Blast Furnace." Outstanding features of his work were his theory of the constitution of cast iron and his theory of the critical temperature of the blast furnace.

Portable Pumping Plant for General Municipal Use

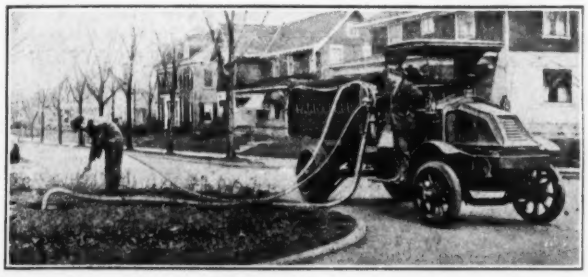
A portable pumping plant and catch-basin cleaner that can be used for a great variety of municipal uses has been put on the market by the Springfield Engineering Co., of Springfield, Ohio. It consists in the main of a pumping outfit and a 6-cu.yd. tank, the whole mounted on a standard Kelly-Springfield five-ton chassis. It may be used for cleaning out catch-basins, spraying trees and shrubbery, spraying paint, and for garbage removal.

The pumping unit consists of a centrifugal pump running at 1900 revolutions per minute, driven by a silent chain direct from the drive shaft of the truck. Catch-basin cleaning is accomplished through the injector principle; that is, the material removed from the catch-basin does not pass through the pump, but the necessary lift is created by means of an injector. The vacuum thus produced is about 26 in. When the apparatus is used in this way, the procedure is to fill the tank half full of clear water, the pump then using the tank as a suction well. The tank itself is fitted with a ¼-in. screen behind which the water carrying the solids is deposited. The screen is cleaned by a jet under pressure, through a bypass from the pump. So successfully have the cleaning device and the general arrangement of the discharge pipe in the tank worked that it is possible to get from 4 to 4½ cu.yd. of solids in the tank on the completion of the operation. The lid of the tank can be screwed down tight, so there is no slopping of liquid into the street. When the tank is filled the truck can run to the dumping ground, and the body is then tilted by means of a hydraulic hoist, the tail of the tank being hinged so that no shoveling is necessary. The tail end is fitted with a gasket so that there is no leakage during pumping operations.

For spraying purposes the spray material or paint is put in the tank, and passes directly through the pump, the pressure at the jets under these conditions being from 100 to 105 lb. per square inch.

By removing the screen in the tank the body can be used for garbage or ash removal.

The machine described above is listed as the G-1. The G-2 machine is the same, except that there is in addition a pressure tank on top of the pump, and the truck is fitted with four flushing and two sprinkler heads, so that the machine can be used for street flushing and sprinkling.



PORTABLLE PUMPING PLANT CLEANING CATCH-BASINS

Federal Trade Commission Loses Its Chief Counsel

Announcement is made by the Federal Trade Commission that its chief counsel, John Walsh of Wisconsin, has resigned to resume the private practice of law in Washington. His resignation was accepted, to take effect Apr. 15.

BUSINESS NEWS

The Chicago Pneumatic Tool Co. has moved its Milwaukee office from room 1315 to 1418 Majestic building, to obtain larger quarters.

J. E. Mason, Western advertising representative of *Engineering News-Record*, has resigned to enter the sales department of the Blaw-Knox Co., at Pittsburgh. Mr. Mason is succeeded by Fred G. Hudson, formerly Western manager of *Chemical & Metallurgical Engineering*, McGraw-Hill Co., Incorporated.

The Neptune Meter Co., of New York City, has acquired a building from the Russell Motor Car Co. of Toronto, Canada, for the manufacture of Trident water meters for Canadian trade, under the name of Neptune Meter Co., Ltd. The manager-director for the Canadian branch is William H. Randall, formerly superintendent of the maintenance and distribution department of the Toronto Water Works.

The appointment of E. E. Maher, formerly Western manager of the Lea-Courtenay Co., and more recently district manager for the Terry Steam Turbine Co., is announced by the Dayton-Dawd Co., Quincy, Ill., manufacturer of centrifugal and underwriters' fire pumps. He will be manager of the Chicago branch, with offices at 30 North Michigan Boulevard.

The American Steam Conveyor Corporation, of Chicago, announces the appointment of Charles H. Florandin, formerly of the National Electric and Welding Co., of New York, as general manager of Eastern territory.

The A. P. Green Fire Brick Co. of Mexico, Mo., has opened an Eastern district sales office at 30 Church St., New York City. Howard C. Thayer, formerly field mechanical engineer for the J. G. White Engineering Corporation at the United States Nitrate Plant No. 2, is in charge.

TRADE PUBLICATIONS

A new booklet on path-digging, self-feeding, self-propelling wagon loaders has just been issued by the George Haiss Mfg. Co., Inc., 142nd St. and Rider Ave., New York City.

"Tile Drainage" is the subject of a new book written by James A. King, of the King Farms Co., Otranto Station, Iowa. The publishers and owners of the copyright are the Mason City Brick & Tile Co., of Mason City, Iowa. The booklet deals with various phases of farm drainage.

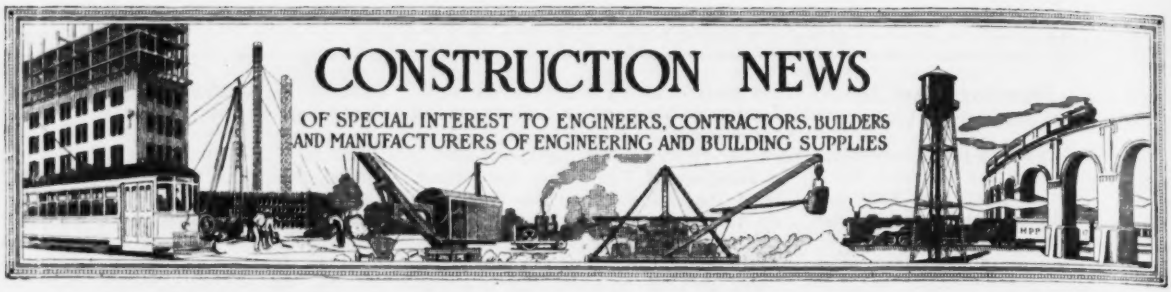
The Western Wheeled Scraper Co., of Aurora, Ill., has just issued an 8-p., 9 x 11-in. pamphlet showing a number of new machines and devices for handling road work on large contracts.

The Guarantee Trust Co. of New York has just issued an illustrated booklet, entitled "Shipping's Share in Foreign Trade—Fundamentals of Ocean Transportation." The book is one of a series dealing with export trade, and is written to meet the needs of beginners in the field, and to be a handy reference for the experienced trader. It contains information for fixing rates, computing the capacity of vessels, the customary commercial terms used in quoting prices to foreign buyers, etc.

"Pile Hammers" is the title of bulletin No. 25, issued by the McKiernan-Terry Drill Co., Park Row Building, New York City. The pamphlet is 6 x 9 in. and has 43 pages. It describes the method of using the various sizes of double-acting steam hammers in the driving of both heavy and light sections of wood and steel sheeting and concrete piles.

The Austin Manufacturing Co., of Chicago, has just issued a 9 x 12-in. pamphlet of 4 pp., dealing with road rollers of both the steam and gasoline-driven type.

"Lidgerwood Coal-Handling Cableways" is the title of bulletin No. 34 issued by the Lidgerwood Manufacturing Co., 96 Liberty St., New York City. The possibilities of cableways for storing coal are set forth, and diagrams of the various layouts for utilizing them are outlined.



CONSTRUCTION NEWS

OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
Apr. 28	New Ulm, Minn.	Apr. 24
May 1	Poughkeepsie, N. Y.	Apr. 17
May 5	Pottsville, Pa.	Apr. 17
	Adv. Apr. 17 and 24.	
May 5	Salt Lake City, Utah	Apr. 24
May 6	Ely, Minn.	Apr. 17
	Adv. Apr. 17 and 24.	
May 8	Brainerd, Minn.	Apr. 24
May 13	Hollandale, Miss.	Apr. 17
May 14	Gilboa, N. Y.	Apr. 17
	Adv. Apr. 10 to 24.	
May 29	Tamaqua, Pa.	Apr. 24
	Adv. Apr. 24.	

SEWERS

Apr. 28	Flagstaff, Ariz.	Apr. 10
	Adv. Apr. 10 and 17.	
Apr. 28	Elkhart Lake, Wis.	Apr. 24
Apr. 29	New Haven, Conn.	Apr. 24
Apr. 30	West Roxbury, Mass.	Apr. 10
Apr. 30	Detroit, Mich.	Apr. 24
Apr. 30	Detroit, Mich.	Apr. 17
May 1	Duluth, Minn.	Apr. 3
May 1	La Grange, Ga.	Apr. 17
	Adv. Apr. 17 and 24.	
May 5	Macon, Mo.	Apr. 17
	Adv. Apr. 17 and 24.	
May 6	Newark, N. J.	Apr. 3
May 6	Cleveland, O.	Apr. 10
	Adv. Apr. 3 and 10.	
May 8	Platte, S. D.	Apr. 17
	Adv. Apr. 17 and 24.	
May 12	Pontiac, Mich.	Apr. 24
	Adv. Apr. 24.	
May 13	Newark, N. J.	Apr. 24
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 20	Erie, Pa.	Apr. 24
	Adv. Apr. 24.	
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	

BRIDGES

Apr. 24	Provo, Utah	Apr. 17
Apr. 28	Idaho Falls, Idaho	Apr. 17
Apr. 28	Toledo, Wash.	Apr. 17
Apr. 28	Owen Sound, Ont.	Apr. 24
Apr. 29	Franklin, Pa.	Apr. 10
	Adv. Apr. 10.	
Apr. 29	Ottawa, Ont.	Apr. 10
Apr. 29	Ann Harbor, Mich.	Apr. 17
Apr. 30	Clarksdale, Miss.	Apr. 17
Apr. 30	Lockhart, S. C.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 30	Dennison, Ia.	Apr. 24
May 3	North Adams, Mass.	Apr. 24
	Adv. Apr. 17 and 24.	
May 3	St. Louis, Mo.	Apr. 24
May 5	Akron, O.	Apr. 10
	Adv. Apr. 10 and 17.	
May 15	Valdosta, Ga.	Apr. 24
May 16	Thomasville, Ga.	Apr. 24
May 19	Cottonwood, Ariz.	Apr. 24

STREETS AND ROADS

Apr. 25	Trenton, N. J.	Apr. 17
Apr. 25	Connecticut	Apr. 17
	Adv. Apr. 17.	
Apr. 25	Ridgefield, Conn.	Apr. 17
	Adv. Apr. 17	
Apr. 25	Edenburg, Pa.	Apr. 10
Apr. 26	Weston, W. Va.	Apr. 17
Apr. 27	Pittsburgh, Pa.	Apr. 3
Apr. 27	Elmira Heights, N. Y.	Apr. 24
	Adv. Apr. 17 and 24.	
Apr. 28	Pennsboro, W. Va.	Apr. 17
Apr. 28	Elmira, N. Y.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 28	St. George, S. I., N. Y.	Apr. 24
Apr. 28	Washington	Apr. 17
Apr. 28	Scranton, Pa.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 28	St. James, Minn.	Apr. 17
	Adv. Apr. 17.	
Apr. 28	Manitowac, Wis.	Apr. 24
Apr. 29	Maryland	Apr. 17
Apr. 29	St. George, S. I., N. Y.	Apr. 24
Apr. 29	Toledo, O.	Apr. 24
Apr. 30	Illinois	Apr. 24
Apr. 30	New Hampshire	Apr. 24
Apr. 30	Akron, O.	Apr. 10
Apr. 30	New York, N. Y.	Apr. 10
	Adv. Apr. 10 to 24.	
Apr. 30	Delaware	Apr. 17
Apr. 30	St. James, Minn.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 30	New Jersey	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 30	Freehold, N. J.	Apr. 17
	Adv. Apr. 17 and 24.	
May 1	Sheboygan, Wis.	Apr. 24
May 1	Augusta, Ga.	Apr. 17
	Adv. Apr. 17 and 24.	
May 1	Olympia, Wash.	Apr. 17
May 1	Wisconsin	Apr. 17
May 1	Illinois	Apr. 24
May 1	Longueuil, Que.	Apr. 24
May 1	Santa Barbara, Cal.	Apr. 24
May 2	St. George, S. I., N. Y.	Apr. 24
May 2	Pennsylvania	Apr. 10
	Adv. Apr. 10 to 24.	
May 3	Terra Haute, Ind.	Apr. 24
May 5	Greenfield, Ind.	Apr. 17
May 5	North Dakota	Apr. 10
May 5	Worthington, Minn.	Apr. 10
May 5	Fayetteville, W. Va.	Apr. 17
	Adv. Apr. 10 to 24.	
May 5	Colfax, Wash.	Apr. 24
May 5	Dallas, Tex.	Apr. 17
	Adv. Apr. 17 and 24.	
May 6	Detroit, Minn.	Apr. 24
May 6	Durham, N. C.	Apr. 17
	Adv. Apr. 17.	
May 6	Upper Marlboro, Md.	Apr. 24
May 6	Edgerton, O.	Apr. 24
May 7	Burlington, N. J.	Apr. 10
May 7	Long Prairie, Minn.	Apr. 17
May 7	Faribault, Minn.	Apr. 17
May 7	Manhattan Beach, Cal.	Apr. 24
May 7	Guelph, Ont.	Apr. 24
May 7	New Jersey	Apr. 24
May 7	Burlington, N. J.	Apr. 24
	Adv. Apr. 24.	
May 7	Arkansas	Apr. 24
	Adv. Apr. 24.	
May 9	Norfolk, Va.	Apr. 24
	Adv. Apr. 24.	
May 9	Patchogue, N. Y.	Apr. 24
	Adv. Apr. 24.	
May 12	Elk River, Minn.	Apr. 17
May 12	David City, Neb.	Apr. 24
May 12	Wahoo, Neb.	Apr. 24
May 12	St. Paul, Neb.	Apr. 24
May 12	New Jersey	Apr. 24
May 12	Salem, N. J.	Apr. 24
May 13	Beatrice, Neb.	Apr. 24
May 14	Arkansas	Apr. 17
	Adv. Apr. 17 and 24.	
May 14	Austin, Minn.	Apr. 24
May 14	Nebraska City, Neb.	Apr. 24
May 14	Humphrey, Neb.	Apr. 24
May 15	Rushville, Neb.	Apr. 24
May 15	Hastings, Minn.	Apr. 24
May 15	Terra Haute, Ind.	Apr. 24
May 15	Plymouth, Wis.	Apr. 10
May 15	Bridgeville, Pa.	Apr. 24
May 16	Toronto, Ont.	Apr. 24
May 19	Merced, Cal.	Apr. 10
May 19	Tulsa, Okla.	Apr. 17
	Adv. Apr. 17 and 24.	
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 20	Windom, Minn.	Apr. 24
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 30	Dallas, Tex.	Apr. 17
	Adv. Apr. 17 and 24.	
June 2	St. Severe, Que.	Apr. 24
June 10	Clarksville, Pa.	Apr. 3

EXCAVATION AND DREDGING

Apr. 28	Sterling, Ill.	Apr. 17
	Adv. Apr. 10 to 24.	
Apr. 28	New York, N. Y.	Apr. 24
Apr. 28	Benson, Minn.	Apr. 17
Apr. 29	New York, N. Y.	Apr. 3
	Adv. Apr. 3 to 24.	
Apr. 29	Jonesboro, Ark.	Apr. 24
Apr. 30	Marion, Kan.	Apr. 17
	Adv. Apr. 17 and 24.	
May 2	Marks, Miss.	Apr. 17
May 6	Paragould, Ark.	Apr. 3
May 14	Poplar Bluff, Mo.	Apr. 3
May 15	Mobile, Ala.	Apr. 10
	Adv. Apr. 10 to 24.	
June 2	Beaufort, N. C.	Apr. 24
	Adv. Apr. 24.	

INDUSTRIAL WORKS

Apr. 26	Altoona, Pa.	Apr. 24
Apr. 28	Providence, R. I.	Apr. 24
Apr. 30	Brooklyn, N. Y.	Apr. 24
Apr. 30	Newark, N. J.	Apr. 24
May 1	New York, N. Y.	Apr. 17
May 1	Brainerd, Minn.	Mar. 27
May 1	Joplin, Mo.	Apr. 3
May 10	Sheboygan, Wis.	Apr. 24
May 15	Toronto, Ont.	Apr. 24
May 15	Bemidji, Minn.	Apr. 17

BUILDINGS

Apr. 25	Green River, Wyo.	Apr. 24
Apr. 26	Lackawana, N. Y.	Apr. 24
Apr. 28	Campbell, Minn.	Apr. 17
Apr. 29	Leon, Ia.	Apr. 24
Apr. 29	Hiawatha, Utah	Apr. 24
Apr. 29	Philadelphia, Pa.	Apr. 24
Apr. 30	London, Ont.	Apr. 24
Apr. 30	Vancouver, B. C.	Apr. 10
Apr. 30	Albany, N. Y.	Apr. 17
	Adv. Apr. 17.	
Apr. 30	Brooklyn, N. Y.	Apr. 24
Apr. 30	Lakewood, N. J.	Apr. 24
May 1	Wakefield, Minn.	Mar. 20
May 1	Virginia, Minn.	Mar. 27
May 1	St. Louis, Mo.	Apr. 3
May 3	Chicoutimi, Que.	Apr. 24
May 3	Racine, Wis.	Apr. 17
Apr. 5	Akron, O.	Apr. 17
May 5	Bridgeport, Conn.	Apr. 24
May 6	Bayonne, N. J.	Apr. 24
May 7	Fort William, Ont.	Apr. 24
May 8	Newark, N. J.	Apr. 17
	Adv. Apr. 17 and 24.	
May 8	Salisbury Center, N. Y.	Apr. 24
May 8	Victoria, Minn.	Apr. 24
May 12	Flint, Mich.	Apr. 17
May 12	Hawley, Minn.	Apr. 24
May 15	Port Washington, Wis.	Apr. 24
May 15	Verona, N. J.	Apr. 10
May 15	Kearney, Minn.	Apr. 17
May 15	Winnibago, Minn.	Apr. 24

FEDERAL GOVERNMENT WORK

Apr. 26	Dredging—Norfolk, Va.	Apr. 10
	Adv. Apr. 10.	
Apr. 28	Hangars — Spec. 3792 — Brunswick, Ga.	Apr. 17
Apr. 28	Storehouse — Spec. 3861 — Hampton Roads, Va.	Apr. 24
Apr. 28	Storehouse — Spec. 3860 — Hampton Roads, Va.	Apr. 24
Apr. 28	Storehouse — Spec. 3859 — Hampton Roads, Va.	Apr. 24